CHAPTER 49

LIST OF EFFECTIVE TEMPORARY REVISIONS

FOLLOWING IS A COMPLETE LISTING OF ALL ACTIVE TEMPORARY REVISIONS (TR'S). TR'S NOT LISTED SHOULD BE REMOVED. THE ATA NUMBER, CONFIG CODE AND PAGE NUMBER IDENTIFIES THE PAGE PRECEDING THE TR.

TR NUMBER	ATA NUMBER	CONFIG CODE	PAGE NUMBER	TR DATE
NONE				

CHAPTER 49

AIRBORNE AUXILIARY POWER

LIST OF EFFECTIVE PAGES

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
List of Effective Pages	1	Jun 15/96	
	2	Jun 15/96	
	3	Jun 15/96	
	4	Jun 15/96	
	5	Jun 15/96	
	6	Jun 15/96	
	7	Jun 15/96	
	8	Jun 15/96	
Table of Contents	1	Jun 15/92	
	2	Jun 15/92	
	3	May 15/89	
	4	May 15/89	
	5	May 15/89	
	6	May 15/89	
	7	May 15/89	
	8	May 15/89	
	9	May 15/89	
	10	May 15/89	
49-conts	1	Jun 15/92	
49-conts	2	Jun 15/93	
49-conts	3	Dec 15/93	
49-conts	4	Jul 15/84	
49-conts	5/6	May 15/82	
49-DIAGM	1	Jun 15/93	
49-DIAGM	2	May 15/82	
49-DIAGM	3	Nov 15/82	
49-DIAGM	4	May 15/82	
49-DIAGM	5/6	May 15/88	
49-INDEX	1	Jun 15/93	
49-INDEX	2	Dec 15/93	
49-INDEX	3	May 15/82	
49-INDEX	4	May 15/82	
49-INDEX	5	May 15/88	
49-INDEX	6	Nov 15/88	
49-INDEX	7/8	May 15/88	
49-00-00	1	May 15/76	
49-00-00	2	Nov 15/86	
49-00-00	3	Nov 15/86	
49-00-00	4	May 15/88	
49-00-00	5	Dec 15/80	
49-00-00	6	May 15/88	
49-00-00	7	May 15/87	
49-00-00	8	Nov 15/86	
49-00-00	9	Nov 15/86	
49-00-00	10	Nov 15/86	
49-00-00	11/12	Nov 15/86	
49-00-00	13	Nov 15/86	
49-00-00	14	Nov 15/86	
49-00-00	15/16	Nov 15/86	
49-00-00	17/18	Nov 15/86	
49-00-00	19	May 15/87	
49-00-00	20	May 15/87	
49-00-00	21	Nov 15/86	
49-00-00	22	Nov 15/86	
49-00-01	201	May 15/88	
49-00-01	202	May 15/88	
49-00-01	203/204	May 15/88	
49-00-01	401	Feb 15/77	
49-00-01	402	Dec 15/95	
49-00-01	403	May 15/75	
49-00-01	404	May 15/75	
49-00-01	405	May 15/75	
49-00-01	406	Dec 15/95	
49-00-01	407	Dec 15/95	
49-00-01	408	Dec 15/95	
49-00-01	409	Dec 15/95	
49-00-01	410	Dec 15/95	
49-00-01	411	Dec 15/95	
49-00-01	412	Dec 15/95	
49-00-01	413	Dec 15/95	
49-00-01	414	Dec 15/95	
49-00-01	415	Dec 15/95	
49-00-01	416	Dec 15/95	
49-00-01	501	May 15/88	
49-00-01	502	Nov 15/83	
49-00-01	503	Nov 15/83	
49-00-01	504	May 15/88	
49-00-01	505	May 15/88	
49-00-01	506	May 15/88	
49-00-01	507	May 15/88	
49-00-01	508	May 15/88	
49-00-01	509	May 15/88	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
49-00-01	510	May 15/88	
49-00-01	511	May 15/88	
49-00-01	512	May 15/88	
49-00-01	513	May 15/88	
49-00-01	514	May 15/88	
49-00-01	515	May 15/88	
49-00-01	516	Nov 15/88	
49-00-01	517	Nov 15/88	
49-00-01	518	Jun 15/93	
49-00-01	519	Jun 15/93	
49-00-01	520	Jun 15/93	
49-00-01	521	Jun 15/93	
49-00-01	522	Jun 15/93	
49-00-01	601	Feb 15/77	
49-00-01	602	Feb 15/77	
49-00-01	603	Jul 15/83	
49-00-01	604	Jul 15/83	
49-00-01	605	Jul 15/83	
49-00-01	606	Jul 15/83	
49-00-01	901	Aug 15/81	
49-00-01	902	Aug 15/81	
49-00-01	903/904	Aug 15/81	
49-00-02	401	Nov 15/82	
49-00-02	402	Nov 15/89	
49-00-02	403	Dec 15/95	
49-00-02	404	Dec 15/95	
49-00-02	405/406	Dec 15/91	
49-00-06	401	Aug 15/81	
49-00-06	402	Aug 15/81	
49-00-07	401	Aug 15/81	
49-00-07	402	Aug 15/75	
49-00-07	403/404	Aug 15/75	
49-00-99	401/402	Aug 15/75	
49-11-00	1	Jun 15/92	
49-11-00	2	Nov 15/84	
49-11-00	3	Dec 15/80	
49-11-00	4	May 15/87	
49-11-00	5/6	Aug 15/81	
49-11-00	7/8	Dec 15/80	
49-11-00	9	Dec 15/80	
49-11-00	10	Nov 15/84	
49-11-00	11	Nov 15/84	
49-11-00	12	Dec 15/80	
49-11-00	13	Dec 15/80	
49-11-00	14	Nov 15/84	
49-11-00	15/16	May 15/87	
49-11-00	17	May 15/87	
49-11-00	18	Nov 15/84	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
49-11-00	19	May 15/87	
49-11-00	20	Nov 15/84	
49-11-00	21	May 15/87	
49-11-00	22	Nov 15/84	
49-11-00	23	May 15/87	
49-11-00	24	May 15/87	
49-11-00	25	Nov 15/84	
49-11-00	26	Nov 15/84	
49-11-00	27/28	Nov 15/84	
49-11-00	29	May 15/87	
49-11-00	30	May 15/87	
49-11-00	31/32	May 15/87	
49-11-00	101	Jun 15/92	
49-11-00	102	May 15/87	
49-11-00	103	May 15/87	
49-11-00	104	May 15/87	
49-11-00	105	Dec 15/93	
49-11-00	106	Jun 15/93	
49-11-00	107	Dec 15/93	
49-11-00	108	Dec 15/93	
49-11-00	109	Jun 15/93	
49-11-00	110	May 15/88	
49-11-00	111	May 15/87	
49-11-00	112	May 15/87	
49-11-00	113	Dec 15/93	
49-11-00	114	May 15/87	
49-11-00	115	May 15/87	
49-11-00	116	May 15/87	
49-11-00	117	May 15/87	
49-11-00	118	May 15/87	
49-11-00	119	May 15/88	
49-11-00	120	Jun 15/93	
49-11-00	121	May 15/88	
49-11-00	122	May 15/87	
49-11-00	123	May 15/87	
49-11-00	124	May 15/87	
49-11-00	125	May 15/87	
49-11-00	126	May 15/87	
49-11-00	127	May 15/87	
49-11-00	128	May 15/87	
49-11-00	129	May 15/87	
49-11-00	130	May 15/87	
49-11-00	131	May 15/87	
49-11-00	132	May 15/87	
49-11-00	133	May 15/87	
49-11-00	134	May 15/87	
49-11-00	135	May 15/87	
49-11-00	136	May 15/87	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
49-11-00	137	May 15/87	
49-11-00	138	May 15/87	
49-11-00	139	May 15/87	
49-11-00	140	May 15/87	
49-11-00	141	May 15/87	
49-11-00	142	May 15/87	
49-11-00	143	May 15/87	
49-11-00	144	May 15/87	
49-11-00	145	May 15/87	
49-11-00	146	May 15/87	
49-11-00	147	May 15/87	
49-11-00	148	May 15/87	
49-11-00	149	May 15/87	
49-11-00	150	Nov 15/88	
49-11-00	151	Nov 15/88	
49-11-00	152	Nov 15/88	
49-11-00	153	Nov 15/88	
49-11-00	154	Nov 15/88	
49-11-00	155	Nov 15/88	
49-11-00	156	Nov 15/88	
49-11-00	157	Nov 15/88	
49-11-00	158	Nov 15/88	
49-11-00	159	Nov 15/88	
49-11-00	160	Nov 15/88	
49-11-00	161	Nov 15/88	
49-11-00	162	Nov 15/88	
49-11-00	163	Nov 15/88	
49-11-00	164	Mar 15/91	
49-11-00	165	Nov 15/88	
49-11-00	166	Nov 15/88	
49-11-00	167	Nov 15/88	
49-11-00	168	Nov 15/88	
49-11-00	169	Nov 15/88	
49-11-00	170	May 15/89	
49-11-00	171	Nov 15/88	
49-11-00	172	Nov 15/88	
49-11-00	173	Nov 15/88	
49-11-00	174	Nov 15/88	
49-11-00	175	Jun 15/93	
49-11-00	176	Nov 15/88	
49-11-00	177	Nov 15/88	
49-11-00	178	Nov 15/88	
49-11-00	179	Jun 15/93	
49-11-00	180	Nov 15/88	
49-11-00	181	Jun 15/93	
49-11-00	182	Nov 15/88	
49-11-00	183	Nov 15/88	
49-11-00	184	Nov 15/88	
49-11-00	185	Nov 15/88	
49-11-00	186	Nov 15/88	
49-11-00	187	Nov 15/88	
49-11-00	188	Nov 15/88	
49-11-00	189	Nov 15/88	
49-11-00	190	Nov 15/88	
49-11-00	191	Nov 15/88	
49-11-00	192	Nov 15/88	
49-11-00	193	Nov 15/88	
49-11-00	194	Nov 15/88	
49-11-00	195/196	Nov 15/88	
49-11-00	197/198	Nov 15/88	
49-11-00	199/200	Nov 15/88	
49-11-00	201/202	Nov 15/88	
49-11-00	203/204	Nov 15/88	
49-11-00	205/206	Nov 15/88	
49-11-00	207/208	Nov 15/88	
49-11-00	209/210	Dec 15/93	
49-11-00	211/212	Dec 15/93	
49-11-00	213/214	Dec 15/93	
49-11-00	215/216	Nov 15/88	
49-11-00	217/218	Nov 15/88	
49-11-00	219/220	Nov 15/88	
49-11-00	221/222	Dec 15/93	
49-11-00	223/224	Dec 15/93	
49-11-00	225/226	Dec 15/93	
49-11-00	227/228	Dec 15/93	
49-11-00	229/230	Dec 15/93	
49-11-00	231/232	Dec 15/93	
49-11-00	233/234	Dec 15/93	
49-11-00	235/236	Dec 15/93	
49-11-00	237/238	Dec 15/93	
49-11-00	239/240	Dec 15/93	
49-11-00	241/242	Dec 15/93	
49-11-00	243/244	Dec 15/93	
49-11-00	245/246	Dec 15/93	
49-11-00	247/248	Dec 15/93	
49-11-02	401	Apr 1/72	
49-11-02	402	Apr 1/72	
49-11-02	403/404	Apr 1/72	
49-11-03	401	Oct 1/72	
49-11-03	402	Oct 1/72	
49-11-03	403/404	Oct 1/72	
49-11-04	401	May 15/88	
49-11-04	402	May 15/88	
49-11-04	403	Oct 1/72	
49-11-04	404	May 15/88	
49-11-04	405/406	May 15/88	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
49-11-05	201/202	Aug 15/81	
49-11-05	401	May 15/88	
49-11-05	402	May 15/88	
49-11-05	403	Feb 15/76	
49-11-05	404	May 15/88	
49-11-08	401	Jan 15/72	
49-11-08	402	Mar 15/80	
49-11-12	401	Nov 15/86	
49-11-12	402	Sep 15/80	
49-11-12	403/404	Jun 15/93	
49-11-18	401	Dec 15/80	
49-11-18	402	Dec 15/80	
49-11-18	403/404	Sep 15/80	
49-11-20	401	Nov 15/87	
49-11-20	402	Aug 15/76	
49-11-20	403	Nov 15/87	
49-11-20	404	Nov 15/87	
49-11-25	801	May 15/86	
49-11-25	802	May 15/86	
49-11-25	803/804	Nov 15/85	
49-21-00	1	Nov 15/81	
49-21-00	2	Nov 15/81	
49-21-00	3/4	Aug 15/75	
49-21-00	5	Aug 15/75	
49-21-00	6	Nov 15/76	
49-21-00	7	Mar 15/83	
49-21-00	8	Nov 15/81	
49-21-00	9	Nov 15/81	
49-21-00	10	Nov 15/81	
49-21-00	11	Nov 15/81	
49-21-00	12	Nov 15/76	
49-21-00	13/14	Nov 15/76	
49-21-00	15	Nov 15/76	
49-21-00	16	Nov 15/76	
49-21-00	17	Jun 15/80	
49-21-00	18	Nov 15/81	
49-21-00	19	Nov 15/81	
49-21-00	20	Nov 15/81	
49-21-00	21	Nov 15/76	
49-21-00	22	Nov 15/76	
49-21-00	23/24	Nov 15/81	
49-21-01	201	Aug 15/82	
49-21-01	202	Feb 15/82	
49-21-01	203	Aug 15/82	
49-21-01	204	Feb 15/82	
49-21-01	205	Aug 15/82	
49-21-01	206	Feb 15/82	
49-21-01	207/208	Feb 15/82	
49-21-01	301	Nov 15/82	
49-21-01	302	Aug 15/81	
49-21-01	303	Sep 15/80	
49-21-01	304	Sep 15/80	
49-21-01	305	Sep 15/80	
49-21-01	306	Sep 15/80	
49-21-01	307	May 15/75	
49-21-01	308	Aug 15/77	
49-21-01	309	Nov 15/82	
49-21-01	310	Aug 15/77	
49-21-01	311	Aug 15/81	
49-21-01	312	Aug 15/81	
49-21-01	313	Aug 15/81	
49-21-01	314	Aug 15/81	
49-21-04	401	Jun 15/80	
49-21-04	402	Jun 15/80	
49-21-04	403/404	Jun 15/80	
49-21-04	601	Dec 1/71	
49-21-04	602	Dec 1/71	
49-21-04	701/702	Dec 1/71	
49-21-06	401	Aug 15/77	
49-21-06	402	May 15/75	
49-21-06	403/404	Jul 15/84	
49-21-08	401	Aug 15/78	
49-21-08	402	Nov 15/85	
49-21-08	403/404	Aug 15/78	
49-21-09	201	Aug 15/81	
49-21-09	202	Aug 15/81	
49-21-09	401	Aug 15/77	
49-21-09	402	Aug 15/77	
49-21-09	403/404	Aug 15/77	
49-21-09	701	Feb 15/78	
49-21-09	702	Feb 15/78	
49-21-09	703/704	Aug 15/77	
49-31-00	1	Nov 15/81	
49-31-00	2	Feb 15/77	
49-31-00	3	Aug 15/81	
49-31-00	4	Aug 15/81	
49-31-00	5	Aug 15/81	
49-31-00	6	Aug 15/82	
49-31-00	7/8	Aug 15/81	
49-31-00	9/10	Sep 15/80	
49-31-00	11	Nov 15/81	
49-31-00	12	Aug 15/82	
49-31-00	13	Nov 15/81	
49-31-00	14	Nov 15/81	
49-31-00	15	Sep 15/80	
49-31-00	16	Aug 15/82	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
49-31-00	17	Sep 15/80	
49-31-00	18	Aug 15/82	
49-31-00	19	Sep 15/80	
49-31-00	20	Aug 15/81	
49-31-00	21	Nov 15/81	
49-31-00	22	Aug 15/81	
49-31-00	23	Nov 15/81	
49-31-00	24	Aug 15/81	
49-31-00	25	Nov 15/81	
49-31-00	26	Aug 15/82	
49-31-00	27/28	Sep 15/80	
49-31-00	29/30	Aug 15/82	
49-31-01	401	Nov 15/85	
49-31-01	402	Nov 15/85	
49-31-01	403	Nov 15/85	
49-31-01	404	Sep 15/79	
49-31-02	401	Nov 15/83	
49-31-02	402	Nov 15/83	
49-31-02	403	Nov 15/83	
49-31-02	404	Nov 15/83	
49-31-03	401	Feb 15/78	
49-31-03	402	Sep 15/73	
49-31-03	403/404	Nov 15/88	
49-31-05	401	Nov 15/88	
49-31-05	402	Nov 15/88	
49-31-05	403	Nov 15/88	
49-31-05	404	Nov 15/88	
49-31-05	405/406	Nov 15/88	
49-31-06	201	May 15/89	
49-31-06	202	Nov 15/83	
49-31-06	203	Nov 15/83	
49-31-06	204	Nov 15/83	
49-31-06	401	Jul 15/84	
49-31-06	402	Nov 15/74	
49-31-06	403/404	Nov 15/88	
49-31-07	401	Sep 15/79	
49-31-07	402	Dec 1/71	
49-31-07	403/404	Sep 15/79	
49-31-10	401	Nov 15/83	
49-31-10	402	Apr 1/72	
49-31-10	403/404	Sep 15/73	
49-31-11	401	Nov 15/83	
49-31-11	402	Dec 1/71	
49-31-11	403	Nov 15/88	
49-31-11	404	Nov 15/83	
49-31-12	401	Aug 15/81	
49-31-12	402	Aug 15/81	
49-31-12	403/404	Jun 15/79	
49-31-16	401	Nov 15/81	
49-31-16	402	Nov 15/88	
49-31-16	403	Nov 15/81	
49-31-16	404	Nov 15/88	
49-31-16	501	Aug 15/82	
49-31-16	502	Mar 15/84	
49-31-17	401	Nov 15/76	
49-31-17	402	Nov 15/76	
49-31-17	403/404	Nov 15/76	
49-31-18	401	Aug 15/78	
49-31-18	402	Feb 15/78	
49-31-18	403/404	Aug 15/78	
49-31-22	401	Aug 15/77	
49-31-22	402	Aug 15/77	
49-31-22	403/404	Aug 15/77	
49-41-00	1	Jun 15/80	
49-41-00	2	Sep 15/73	
49-41-00	3	Nov 15/82	
49-41-00	4	Jun 15/80	
49-41-00	5	Jun 15/80	
49-41-00	6	May 15/88	
49-41-00	7	Aug 15/77	
49-41-00	8	Jun 15/80	
49-41-01	401	Aug 15/77	
49-41-01	402	Aug 15/77	
49-41-01	601	Aug 15/77	
49-41-01	602	Nov 15/87	
49-41-01	603/604	Aug 15/75	
49-41-01	701	May 15/75	
49-41-01	702	May 15/75	
49-41-02	401	May 15/75	
49-41-02	402	May 15/75	
49-41-02	403/404	May 15/75	
49-41-02	501	Aug 15/81	
49-41-02	502	Aug 15/81	
49-41-02	503/504	Sep 15/79	
49-41-04	401	Nov 15/82	
49-41-04	402	Nov 15/82	
49-41-04	403	May 15/82	
49-41-04	404	Nov 15/82	
49-41-04	405	Nov 15/82	
49-41-04	406	Nov 15/82	
49-41-04	407	Nov 15/82	
49-41-04	408	Nov 15/82	
49-41-06	401	Feb 15/82	
49-41-06	402	Feb 15/82	
49-41-07	401	May 15/90	
49-41-07	402	May 15/90	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
49-41-07	403	May 15/90	
49-41-07	404	May 15/90	
49-51-00	1	Feb 15/78	
49-51-00	2	Feb 15/78	
49-51-00	3/4	Dec 15/80	
49-51-00	5/6	Mar 15/83	
49-51-00	7	Sep 15/80	
49-51-00	8	Sep 15/80	
49-51-00	9	Sep 15/80	
49-51-00	10	Aug 15/82	
49-51-00	11	Sep 15/80	
49-51-00	12	May 15/82	
49-51-00	13	Sep 15/80	
49-51-00	14	Sep 15/80	
49-51-00	15	Sep 15/80	
49-51-00	16	Sep 15/80	
49-51-00	17/18	Aug 15/82	
49-51-03	401	Nov 15/76	
49-51-03	402	Nov 15/76	
49-51-03	403/404	Nov 15/88	
49-51-05	401	Nov 15/88	
49-51-05	402	Nov 15/75	
49-51-05	403/404	Nov 15/88	
49-51-05	501	May 15/87	
49-51-05	502	May 15/87	
49-51-05	503	May 15/87	
49-51-05	504	May 15/87	
49-51-05	601	Aug 15/81	
49-51-05	602	Aug 15/81	
49-51-07	401	Nov 15/86	
49-51-07	402	Aug 15/81	
49-51-07	403	Aug 15/81	
49-51-07	404	Aug 15/81	
49-51-07	405/406	Aug 15/81	
49-51-08	401	Sep 15/79	
49-51-08	402	Apr 1/72	
49-51-08	403/404	Sep 15/79	
49-51-09	401	Dec 15/91	
49-51-09	402	Dec 15/91	
49-51-09	403	May 15/74	
49-51-09	404	Nov 15/87	
49-51-09	405/406	Dec 15/91	
49-51-10	401	Aug 15/81	
49-51-10	402	Aug 15/81	
49-51-10	403	Aug 15/81	
49-51-10	404	Nov 15/83	
49-51-10	405	Aug 15/77	
49-51-10	406	Nov 15/76	
49-51-10	407/408	Nov 15/83	
49-51-11	401	Apr 15/73	
49-51-11	402	Sep 15/80	
49-51-11	403	Nov 15/84	
49-51-11	404	Apr 15/73	
49-51-11	405	Nov 15/84	
49-51-11	406	Nov 15/84	
49-51-13	401	Jan 15/72	
49-51-13	402	Jan 15/72	
49-51-16	401/402	May 15/78	
49-51-16	601/602	Aug 1/72	
49-51-20	401	Feb 15/78	
49-51-20	402	Nov 15/85	
49-51-20	403/404	Feb 15/78	
49-51-21	401	May 15/82	
49-51-21	402	Feb 15/78	
49-51-21	403/404	Nov 15/88	
49-51-21	501	Nov 15/76	
49-51-21	502	Nov 15/88	
49-51-23	601	Aug 15/77	
49-51-23	602	Nov 15/76	
49-51-25	401	May 15/82	
49-51-25	402	May 15/82	
49-51-25	601/602	Nov 15/75	
49-51-25	801	Feb 15/76	
49-51-25	802	Feb 15/76	
49-51-25	803/804	Feb 15/76	
49-51-27	401	Aug 15/77	
49-51-27	402	Nov 15/76	
49-51-27	403/404	Aug 15/77	
49-61-00	1	May 15/88	
49-61-00	2	Jul 15/84	
49-61-00	3	Jul 15/84	
49-61-00	4	Jul 15/84	
49-61-00	5	Nov 15/84	
49-61-00	6	May 15/87	
49-61-00	7/8	Nov 15/84	
49-61-00	9/10	Nov 15/84	
49-61-00	11	Mar 15/81	
49-61-00	12	May 15/88	
49-61-00	13	May 15/88	
R 49-61-00	14	Jun 15/96	
49-61-00	15	May 15/88	
49-61-00	16	May 15/88	
49-61-00	17	Nov 15/84	
49-61-00	18	Nov 15/84	
49-61-00	19	Nov 15/84	
49-61-00	20	Nov 15/84	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
49-61-00	21	May 15/88	
49-61-00	22	May 15/87	
49-61-00	23	May 15/88	
49-61-00	24	May 15/88	
49-61-00	25	May 15/88	
49-61-00	26	May 15/88	
49-61-00	27	May 15/88	
49-61-00	28	May 15/88	
49-61-00	29	May 15/88	
49-61-00	30	Jun 15/92	
49-61-00	31	May 15/90	
49-61-00	32	May 15/88	
49-61-00	33	May 15/88	
49-61-00	34	May 15/88	
49-61-00	35	May 15/88	
49-61-00	36	May 15/88	
49-61-00	37	May 15/88	
49-61-00	38	May 15/88	
49-61-00	39/40	May 15/88	
49-61-00	41/42	Nov 15/88	
49-61-00	43/44	Nov 15/88	
49-61-00	45/46	May 15/88	
49-61-00	47/48	May 15/88	
49-61-00	49/50	May 15/88	
49-61-00	51/52	Nov 15/84	
49-61-00	53/54	Nov 15/84	
49-61-00	55/56	May 15/88	
49-61-00	57/58	Nov 15/84	
49-61-00	59/60	Nov 15/84	
49-61-00	61/62	Nov 15/84	
49-61-00	63	May 15/88	
49-61-00	64	Nov 15/84	
49-61-00	65	Nov 15/84	
49-61-00	66	May 15/88	
49-61-00	67	May 15/88	
49-61-00	68	May 15/88	
49-61-00	69	May 15/88	
49-61-00	70	May 15/88	
49-61-00	71	May 15/88	
49-61-00	72	May 15/88	
49-61-00	73	May 15/88	
49-61-00	74	May 15/88	
49-61-00	75	May 15/88	
49-61-00	76	May 15/88	
49-61-00	77/78	Jun 15/92	
49-61-01	401	Sep 15/80	
49-61-01	402	Sep 15/80	
49-71-00	1	Nov 15/76	
49-71-00	2	Nov 15/76	
49-71-00	3	Nov 15/76	
49-71-00	4	Nov 15/74	
49-71-01	401	Nov 15/74	
49-71-01	402	Nov 15/74	
49-71-01	403	May 15/74	
49-71-01	404	Nov 15/82	
49-71-01	501	Nov 15/76	
49-71-01	502	Nov 15/76	
49-71-01	503/504	Nov 15/76	
49-71-01	601/602	Nov 15/76	
49-71-02	401	May 15/90	
49-71-02	402	Aug 15/75	
49-75-00	1	Aug 15/74	
49-75-00	2	Aug 15/74	
49-75-00	3/4	Oct 1/72	
49-75-01	401	May 15/82	
49-75-01	402	Nov 15/76	
49-75-01	403	May 15/75	
49-75-01	404	Nov 15/88	
49-75-01	405	Nov 15/88	
49-75-01	406	Nov 15/76	
49-75-01	407	May 15/82	
49-75-01	408	May 15/82	
49-75-01	409/410	May 15/82	
49-75-02	401	Aug 15/75	
49-75-02	402	Aug 15/75	
49-75-03	201/202	May 15/85	
49-81-00	1	Nov 15/81	
49-81-00	2	Aug 15/81	
49-81-00	3/4	Aug 15/81	
49-81-01	401	May 15/73	
49-81-01	402	Mar 15/80	
49-81-01	403/404	Aug 15/81	
49-81-02	401	Jan 15/72	
49-81-02	402	Jan 15/72	
49-81-02	403/404	Mar 15/80	
49-81-03	401	Nov 15/85	
49-81-03	402	Nov 15/85	
49-81-03	403	Nov 15/85	
49-81-03	404	Nov 15/85	
49-81-03	405	Nov 15/85	
49-81-03	406	Nov 15/85	
49-81-03	407	Nov 15/85	
49-81-03	408	Nov 15/85	
49-81-03	409	Nov 15/85	
49-81-03	410	Nov 15/85	
49-81-04	401	Nov 15/83	

	CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE	CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
	49-81-04	402	Nov 15/83					
	49-81-04	403	Nov 15/83					
	49-81-04	404	Nov 15/83					
	49-81-04	405/406	Nov 15/83					
	49-91-00	1	Nov 15/75					
R	49-91-00	2	Jun 15/96					
	49-91-00	3	Sep 15/80					
	49-91-00	4	Feb 15/76					
	49-91-00	5	May 15/76					
	49-91-00	6	Nov 15/74					
	49-91-01	401	Dec 15/91					
	49-91-01	402	Dec 15/91					
R	49-91-01	403	Jun 15/96					
	49-91-01	404	Dec 15/91					
	49-91-02	401	Nov 15/81					
	49-91-02	402	Mar 15/83					
	49-91-03	401	Mar 15/91					
	49-91-03	402	Nov 15/88					
	49-91-03	403/404	May 15/74					
	49-91-04	401	Nov 15/81					
	49-91-04	402	Aug 15/[illegible]					
	49-91-04	403/404	Nov 15/81					
	49-91-05	201/202	May 15/85					
	49-91-06	201/202	May 15/85					
	49-91-07	201/202	Mar 15/81					

CHAPTER 49

AIRBORNE AUXILIARY POWER

TABLE OF CONTENTS

	Subject	Chapter Section Subject	Page	Effectivity
	INDEX	49-INDEX		
	FIRM Fault Code Cross Reference		1	ALL
	WORKSHEET	49-WKSH		
	Maintenance Worksheet Reference		1	ALL
	AIRBORNE AUXILIARY POWER	49-00-00		
	Description and Operation		1	ALL
	AUXILIARY POWER UNIT (APU)	49-00-01		
	Maintenance Practices		201	ALL
	Removal/Installation		401	ALL
	Adjustment/Test		501	ALL
	Inspection/Check		601	ALL
R	Storage Instructions		901	ALL
	ELECTRONIC CONTROL UNIT (ECU)	49-00-02		
	Removal/Installation		401	ALL
	PANEL - POWER CONTROL, APU EQUIPMENT	49-00-06		
	Removal/Installation		401	024-999
	REGULATOR - VOLTAGE	49-00-07		
	Removal/Installation		401	ALL
	PANEL - APU CONTROL	49-00-99		
	Removal/Installation		401	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	POWER PLANT	49-10-00		
	APU POWER PLANT	49-11-00		
	Description and Operation		1	ALL
	Fault Isolation		101	ALL
	MOUNT - APU FORWARD VIBRATION	49-11-02		
	Removal/Installation		401	ALL
	MOUNT - APU AFT VIBRATION	49-11-03		
	Removal/Installation		401	ALL
	DOOR - APU AIR INLET	49-11-04		
	Removal/Installation		401	ALL
	ACTUATOR - APU AIR INLET DOOR	49-11-05		
	Maintenance Practices		201	ALL
	Removal/Installation		401	ALL
	TANK - DRIP	49-11-08		
	Removal/Installation		401	ALL
	VALVE - SHUTOFF, APU COMPARTMENT VENTILATION	49-11-12		
R	Removal/Installation		401	001-031
	ACTUATOR - AIR VENT EJECTOR	49-11-18		
	Removal/Installation		401	ALL
	EJECTOR ASSEMBLY - AIR VENT	49-11-20		
	Removal/Installation		401	ALL
	BLANKET - INSULATION, APU COMPARTMENT	49-11-25		
	Approved Repairs		801	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	ENGINE	49-20-00		
	APU GAS TURBINE ENGINE	49-21-00		
R	Description and Operation		1	ALL
	ENGINE - APU GAS TURBINE	49-21-01		
	Maintenance Practices		201	ALL
	Servicing		301	ALL
	ELEMENT - OIL FILTER	49-21-04		
	Removal/Installation		401	ALL
	Inspection/Check		601	ALL
	Cleaning/Painting		701	ALL
	SEAL - OIL, ENGINE STARTER DRIVE	49-21-06		
	Removal/Installation		401	ALL
	FILTER ELEMENT - AIR, ENGINE BLEED VALVE	49-21-08		
	Removal/Installation		401	ALL
	CONNECTOR - MULTIPLE, ENGINE BLEED VALVE	49-21-09		
	Maintenance Practices		201	ALL
	Removal/Installation		401	ALL
	Cleaning/Painting		701	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	ENGINE FUEL AND CONTROL	49-30-00		
	ENGINE FUEL AND CONTROL SYSTEM	49-31-00		
R	Description and Operation		1	ALL
	PUMP - FUEL, ENGINE DRIVEN	49-31-01		
	Removal/Installation		401	ALL
	UNIT - FUEL CONTROL	49-31-02		
	Removal/Installation		401	ALL
	SENSOR - INLET TEMPERATURE	49-31-03		
	Removal/Installation		401	ALL
	CONTROLLER - FREE TURBINE SPEED	49-31-05		
	Removal/Installation		401	ALL
CR	SENSOR JUMPER HARNESS INSTALLATION	49-31-06		
C	Maintenance Practices		201	ALL
	Removal/Installation		401	ALL
	ELEMENT - FUEL FILTER	49-31-07		
R	Removal/Installation		401	ALL
	HEAT EXCHANGER - OIL-TO-FUEL	49-31-10		
	Removal/Installation		401	ALL
	VALVE - AUTOMATIC FUEL SHUTOFF	49-31-11		
	Removal/Installation		401	ALL
	NOZZLE AND ADAPTER ASSEMBLY - FUEL	49-31-12		
	Removal/Installation		401	ALL
	VALVE - FIREWALL FUEL SHUTOFF	49-31-16		
	Removal/Installation		401	ALL
	Adjustment/Test		501	ALL
	VALVE - FUEL FLOW DIVIDER AND DUMP	49-31-17		
	Removal/Installation		401	ALL
	ACTUATOR - FIREWALL FUEL SHUTOFF VALVE	49-31-18		
	Removal/Installation		401	ALL
	FILTER ELEMENT - FCU P3 AIR	49-31-22		
	Removal/Installation		401	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	IGNITION/STARTING	49-40-00		
	IGNITION AND STARTING SYSTEM	49-41-00		
R	Description and Operation		1	ALL
	PLUG - IGNITER	49-41-01		
	Removal/Installation		401	ALL
	Inspection/Check		601	ALL
	Cleaning/Painting		701	ALL
	EXCITER - IGNITION	49-41-02		
	Removal/Installation		401	ALL
	Adjustment/Test		501	ALL
	STARTER - ENGINE	49-41-04		
	Removal/Installation		401	ALL
	RELAY - APU STARTER	49-41-06		
	Removal/Installation		401	ALL
	CLUTCH - STARTER, APU	49-41-07		
	Removal/Installation		401	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	AIR	49-50-00		
	AIR SYSTEMS	49-51-00		
R	Description and Operation		1	ALL
	CONTROLLER - LOAD COMPRESSOR	49-51-03		
	Removal/Installation		401	ALL
	VANE ASSEMBLY - INLET GUIDE	49-51-05		
	Removal/Installation		401	ALL
	Adjustment/Test		501	ALL
	Inspection/Check		601	ALL
	TRANSDUCER - FEEDBACK, INLET GUIDE VANE	49-51-07		
R	Removal/Installation		401	ALL
	TRANSFORMER - CURRENT	49-51-08		
	Removal/Installation		401	ALL
	VALVE - SURGE	49-51-09		
	Removal/Installation		401	ALL
	CONTROLLER AND SHOCK SWITCH - SURGE VALVE	49-51-10		
	Removal/Installation		401	ALL
	DUCT - SURGE	49-51-11		
	Removal/Installation		401	ALL
	DUCT - FAN INLET AIR	49-51-13		
	Removal/Installation		401	ALL
	VALVE - LOAD COMPRESSOR DISCHARGE CHECK	49-51-16		
	Removal/Installation		401	ALL
	Inspection/Check		601	ALL
	AIR FILTER ELEMENT - IGV	49-51-20		
	Removal/Installation		401	ALL
	DIFFERENTIAL PRESSURE SWITCH - LOAD COMPRESSOR AIR INLET	49-51-21		
	Removal/Installation		401	ALL
	Adjustment/Test		501	ALL
	CHIP DETECTOR	49-51-23		
	Inspection/Check		601	ALL
	DUCT - LOAD COMPRESSOR AIR INLET	49-51-25		
	Removal/Installation		401	ALL
	Inspection/Check		601	ALL
	Approved Repairs		801	ALL
	FILTER ELEMENT - ORIFICE	49-51-27		
	Removal/Installation		401	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	ENGINE CONTROLS	49-60-00		
	APU POWER PLANT CONTROL SYSTEM	49-61-00		
R	Description and Operation		1	ALL
	INDICATOR - ELAPSED-TIME	49-61-01		
	Removal/Installation		401	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	INDICATING	49-70-00		
	ENGINE TEMPERATURE INDICATING SYSTEM	49-71-00		
R	Description and Operation		1	ALL
	HARNESS - SENSING, APU ENGINE TEMPERATURE	49-71-01		
	Removal/Installation		401	ALL
	Adjustment/Test		501	ALL
	Inspection/Check		601	ALL
	INDICATOR - TURBINE GAS TEMPERATURE (TGT)	49-71-02		
	Removal/Installation		401	ALL
	Ng INDICATING SYSTEM	49-75-00		
	Description and Operation		1	ALL
	TACHOMETER - GAS GENERATOR	49-75-01		
	Removal/Installation		401	ALL
	INDICATOR - Ng	49-75-02		
	Removal/Installation		401	ALL
	FAULT INDICATOR FLAG - N2 OVERSPEED	49-75-03		
	Maintenance Practices		201	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	EXHAUST	49-80-00		
R	EXHAUST SYTEM Description and Operation	49-81-00	1	ALL
	MUFFLER - APU Removal/Installation	49-81-01	401	ALL
	HOUSING - TRANSITION EXHAUST Removal/Installation	49-81-02	401	ALL
	APU EXHAUST SHROUD Removal/Installation	49-81-03	401	ALL
	SEALS - SHROUD, APU EXHAUST Removal/Installation	49-81-04	401	ALL

	Subject	Chapter Section Subject	Page	Effectivity
	OIL	49-90-00		
	OIL SYSTEM	49-91-00		
R	Description and Operation		1	ALL
	HEAT EXCHANGER - OIL/AIR	49-91-01		
	Removal/Installation		401	ALL
	SWITCH - HIGH OIL TEMP	49-91-02		
	Removal/Installation		401	ALL
	SWITCH - LOW OIL PRESSURE	49-91-03		
	Removal/Installation		401	ALL
	SWITCH - LOW OIL QUANTITY	49-91-04		
	Removal/Installation		401	ALL
	FAULT INDICATOR FLAG - HIGHTEMP	49-91-05		
	Maintenance Practices		201	ALL
	FAULT INDICATOR FLAG - LOW PRESSURE	49-91-06		
	Maintenance Practices		201	ALL
	LIGHT - APU LOW OIL QUANTITY INDICATOR	49-91-07		
	Maintenance Practices		201	ALL

CHAPTER 49-AIRBORNE AUXILIARY POWER

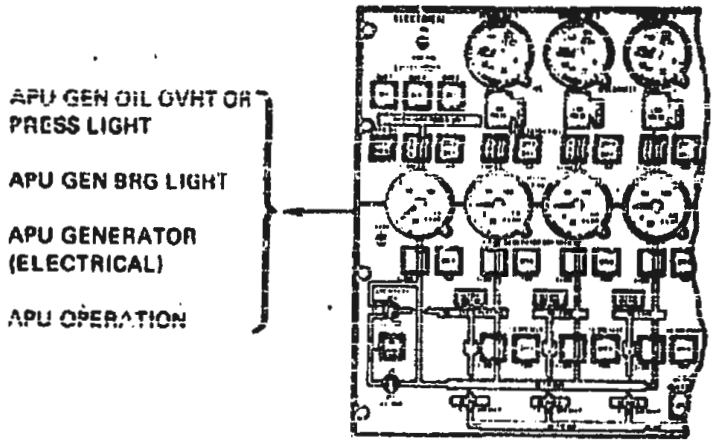
TABLE OF CONTENTS

	Subject	Chapter/ Section Subject	Page
	FAULT CODE DIAGRAMS		1
	FAULT CODE INDEX		1
	POWER PLANT SYSTEM	49-11-00	
R	General		101
	Supplemental data		102
	PREPARATION FOR APU POWER OFF CONTINUITY CHECK		105
	Fault Isolation		119
	Component Locator Index		121
	APU Components Locator		124
	APU Component Locator		134
	APU Components Locator		135
	AUTOFIRE SHUTDOWN ARMED Light Does Not Come On When APU MASTER POWER Switch is Latched		149
	APU Does Not Start, No DOOR IN TRANSIT Light; DONT LOAD Light Not On		150
	Deleted		152
	DOOR IN TRANSIT Light Remains On, APU Starts and Runs		153
	DONT LOAD Light Does Not Come On, APU Starts and Runs		154
	APU Does Not Start. DOOR IN TRANSIT Light On, Then Off; DONT LOAD Light Does Not Come On		155
	APU Does Not Start. No Starter Battery Current; DONT LOAD Light On		156
	APU Does Not Light Off - Hangs at 15-18% Ng, Then Shuts Down		157
	APU Does Not Run; Lights Off, But Hangs Below 55% Ng		163
	EMERGENCY SHUTOFF PRI Light Remains On When APU MASTER POWER Switch is Latched		164

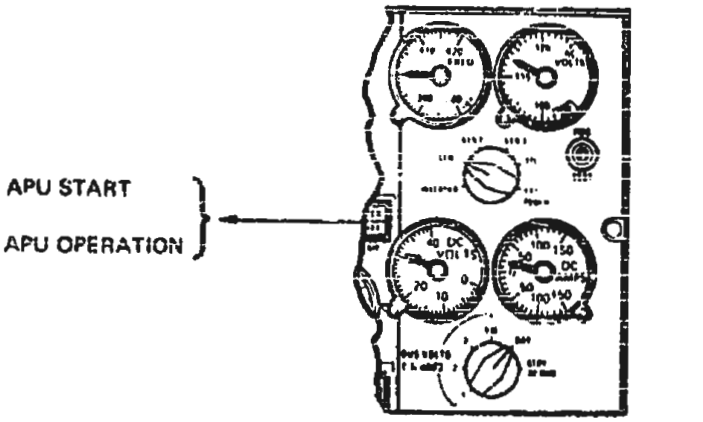
	Subject	Chapter/ Section Subject	Page
	POWER PLANT SYSTEM (CONT)	49-11-00	
	No Ng Indication During Start, Starter Battery Current OK		165
	Low MAX MODE Load Compressor Output		166
	OVERSPEED N2 Trip		169
	APU Shuts Down With LOW PRESS OIL Flag Tripped		171
	APU Shuts Down With HIGH TEMP OIL Flag Tripped		172
	APU Auto Shutdown; No Fault Flag		173
	APU MASTER POWER Switch Does Not Latch On		174
P K	APU Will Not Go Into MAX MODE; OK In NORM MODE		175
	LOW OIL QUANTITY Light Comes On		176
	BLEED AIR S/O OPEN Light Does Not Come On		177
	BLEED AIR S/O OPEN Light On With Switch Out		178
R	APU Does Not Go Into NORM Mode		179
	AUTOFIRE SHUTDOWN ARMED and GEN OIL PRESS Lights Remain On When MASTER POWER is Switched Off		180
R	APU Operates in NORM Mode, With MIN Mode		
R	Selected		181
	APU Operates in MAX MODE At All Times		182
	APU Hangs Up or Accelerates Erratically Between 60% and 90% Ng		185
	APU Cranks But Does Not Light Off, EMERGENCY SHUTOFF SEC Light is On		186
	APU Operating Parameters (Ng, TGT, Duct Pressure, Gen Freq) Fluctuate		187
	TGT Faults		188
	APU Ejector Doors Close When Start Switch Is Released		189
	APU Does Not Shut Down When STOP Switch is Depressed		190
	DOOR IN TRANSIT Light Does Not Indicate Closure of Vent Air Ejector Doors		191
	Autofire Shutdown		192
	APU Shuts Down When APU Generator Comes On The Line		193
	APU Generator Does Not Come On Line; DONT LOAD Light On		195/196
	APU Power Distribution Circuits		197/198

Subject	Chapter/ Section Subject	Page
POWER PLANT SYSTEM (CONT)	49-11-00	
APU Start/Stop Circuit		209/210
APU Start/Stop Circuits		211/212
APU Start/Stop Circuit		215/216
APU Start/Stop Circuits		217/218
APU Start/Stop Circuit		219/220
APU Starter and Ignition Circuits		221/222
APU Engine and Load Compressor Control Circuits		225/226
APU Indicating Circuits		231/232
APU Manual/Autofire Shutdown Circuits		237/238

AIRBORNE AUXILIARY POWER CONTENTS

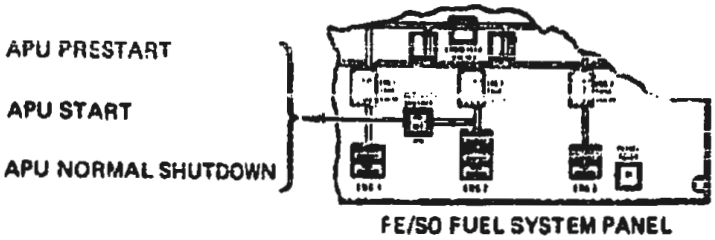


FE/SO ELECTRICAL CONTROL PANEL



FE/SO ELECTRICAL CONTROL PANEL

TITLE	CHAP/SEC
APU GEN OIL OVHT OR PRESS LIGHT . . . . . ELECTRICAL	2441
APU GEN BRG LIGHT . . . ELECTRICAL	2441
APU GENERATOR . . . . . ELECTRICAL	2414
APU PRESTART	4911
APU START	4911
APU OPERATION	4911
APU NORMAL SHUTDOWN	4911

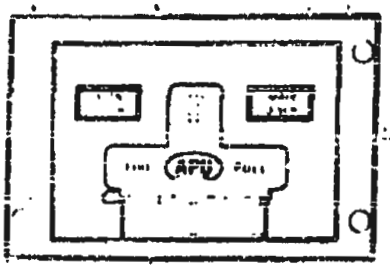


FE/SO FUEL SYSTEM PANEL

M1-0000-49-4206

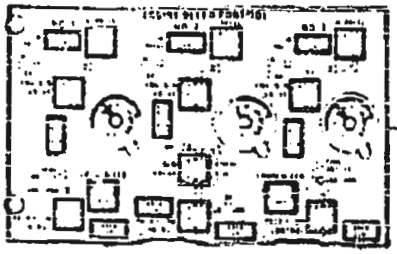
R AIRBORNE AUXILIARY POWER CONTENTS

AIRBORNE AUXILIARY POWER CONTENTS



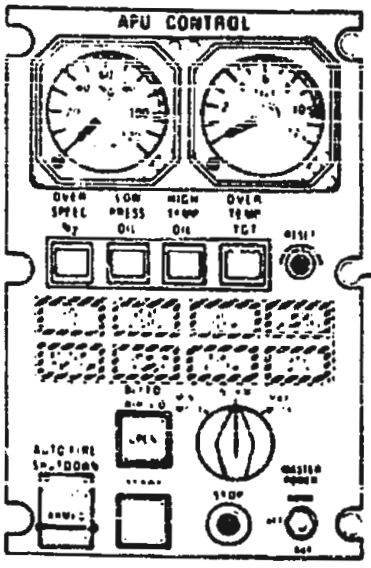
APU AUTO SHUTDOWN

FE/SO APU FIRE CONTROL PANEL.



APU OPERATION

FE/SO ENGINE BLEED CONTROL PANEL

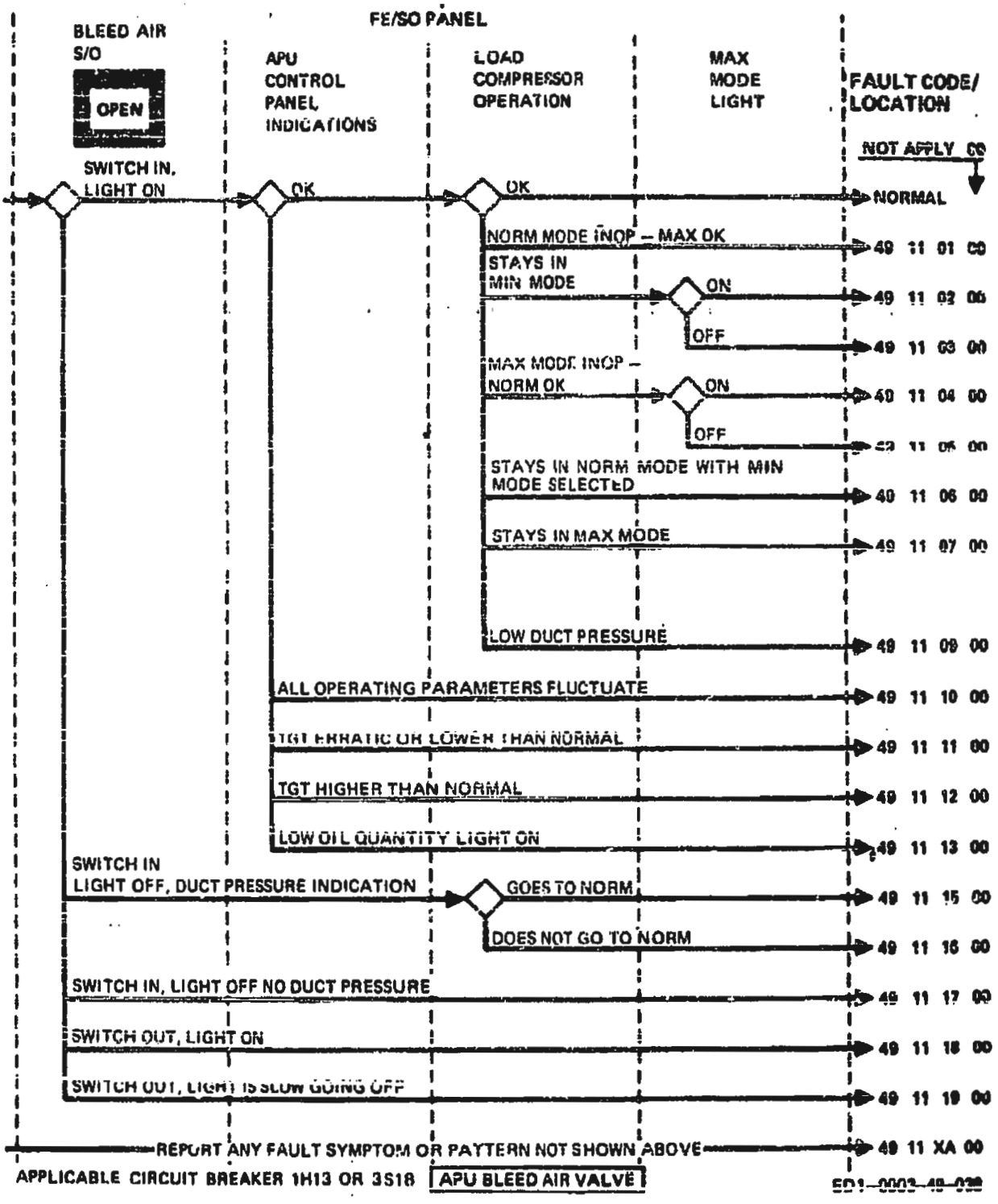


APU PRESTART
APU START
APU OPERATION
APU NORMAL SHUTDOWN
APU AUTO SHUTDOWN
BATTERY CONDITION LIGHT (ELECTRICAL)

FE/SO APU CONTROL PANEL

TITLE	CHAP/SEC
BATTERY CONDITION LIGHT ELECTRICAL	2432
APU PRESTART	4911
APU START	4911
APU OPERATION	4911
APU NORMAL SHUTDOWN	4911
APU AUTO SHUTDOWN	4911

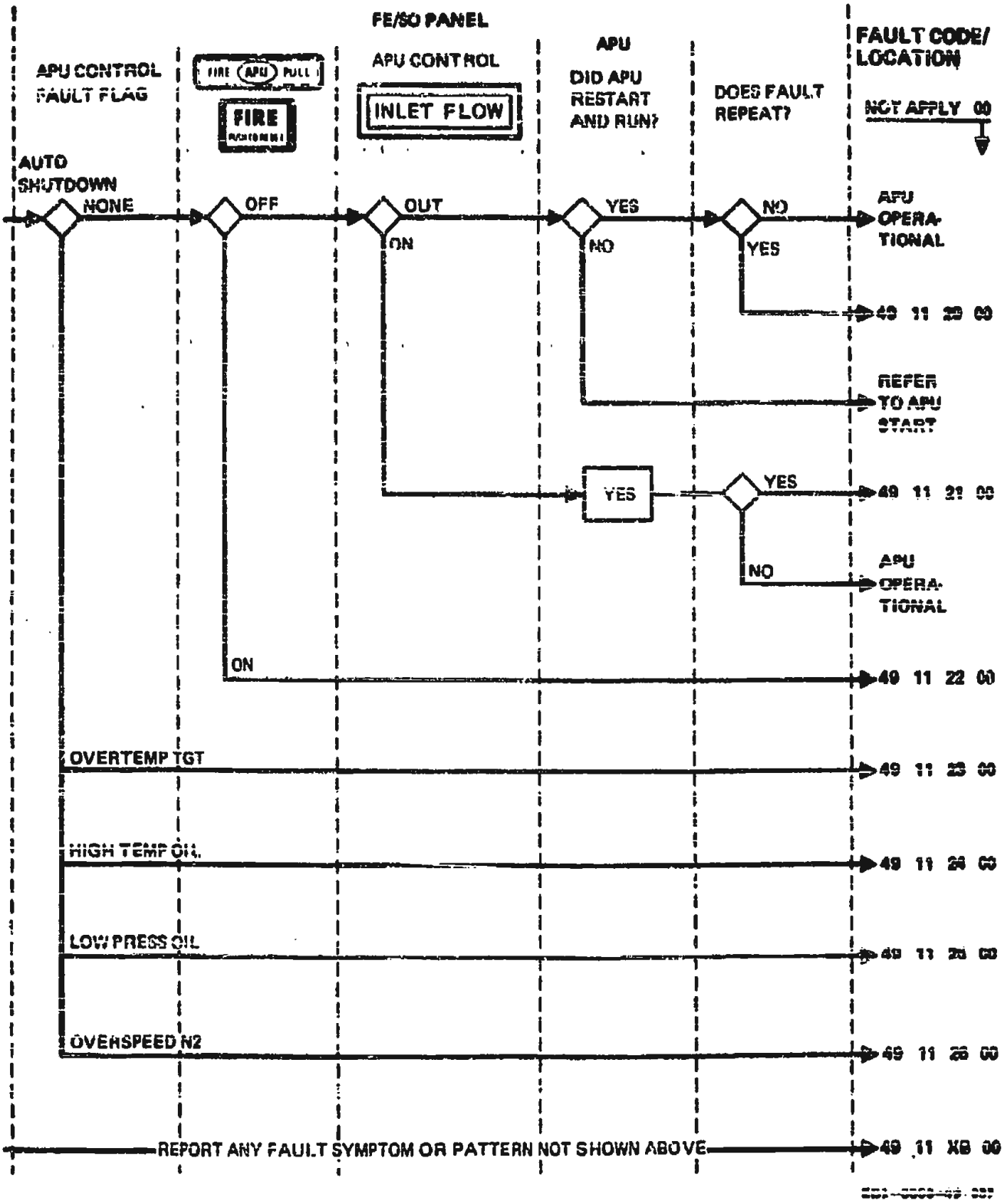
M1-0001-49-0208



R APU Operation - Fault Codes
Figure 1

EFFECTIVITY: ALL

49-FAULT CODE DIAGRAM

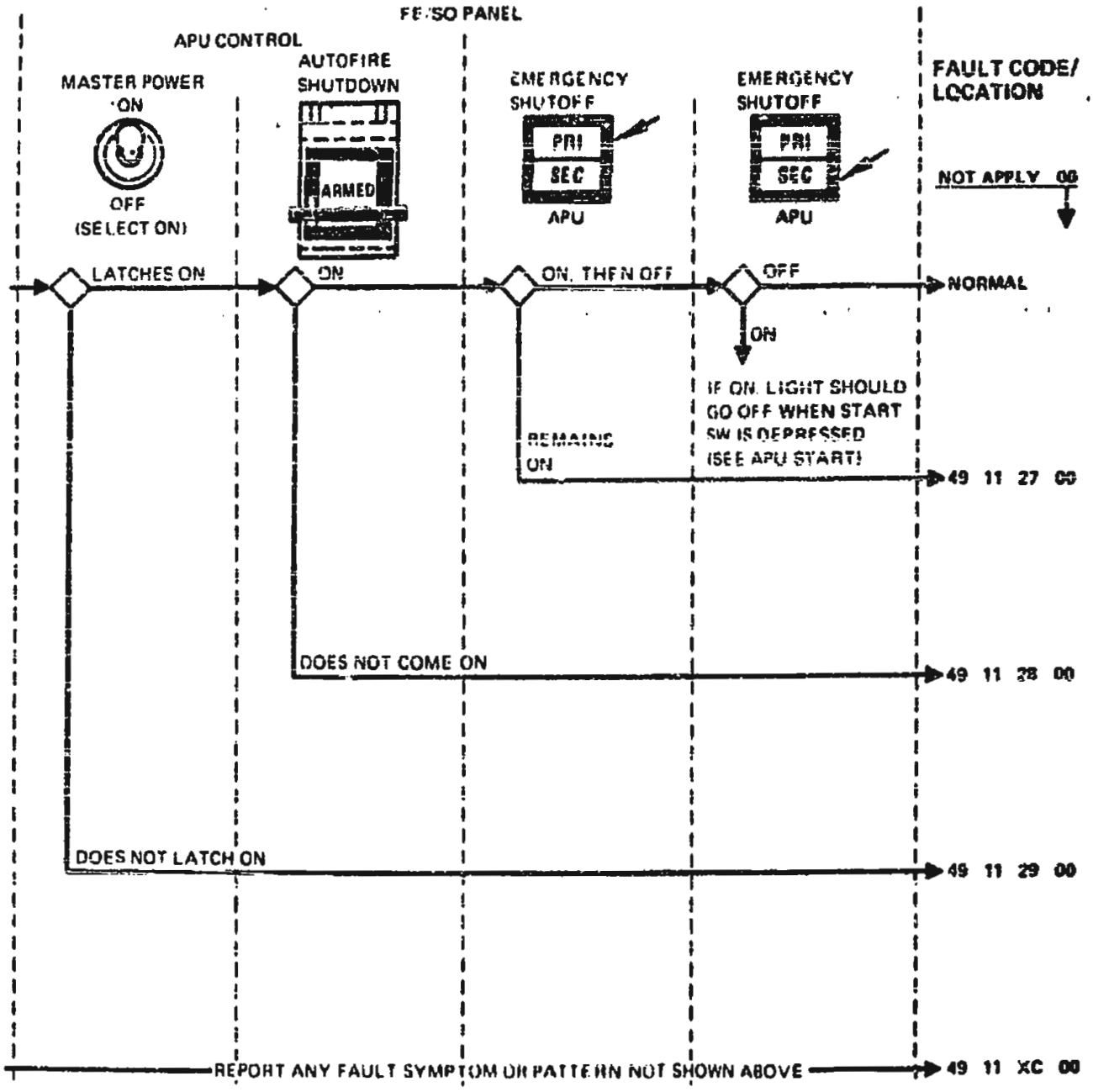


APU Auto Shutdown - Fault Codes
Figure 2

R EFFECTIVITY: ALL

R 050B

49-FAULT CODE DIAGRAM



APPLICABLE CIRCUIT BREAKERS

3B10 BAT PWR
3S7 FIREWALL SHUTOFF -PRIM
3S8 FIREWALL SHUTOFF -SEC
3S12 CONT PWR
3S13 POWER CONTROL

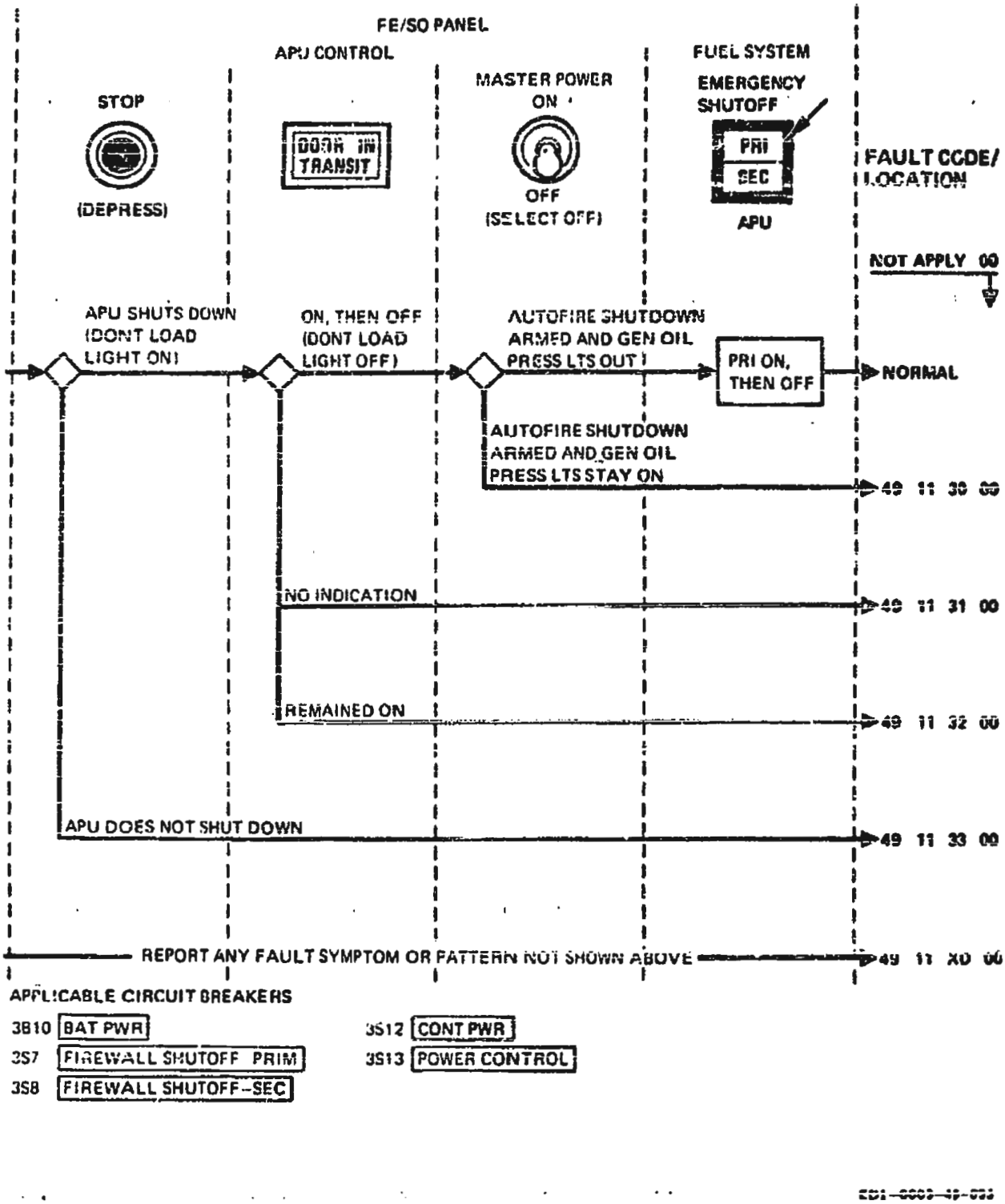
EDI-0002-49-031

R

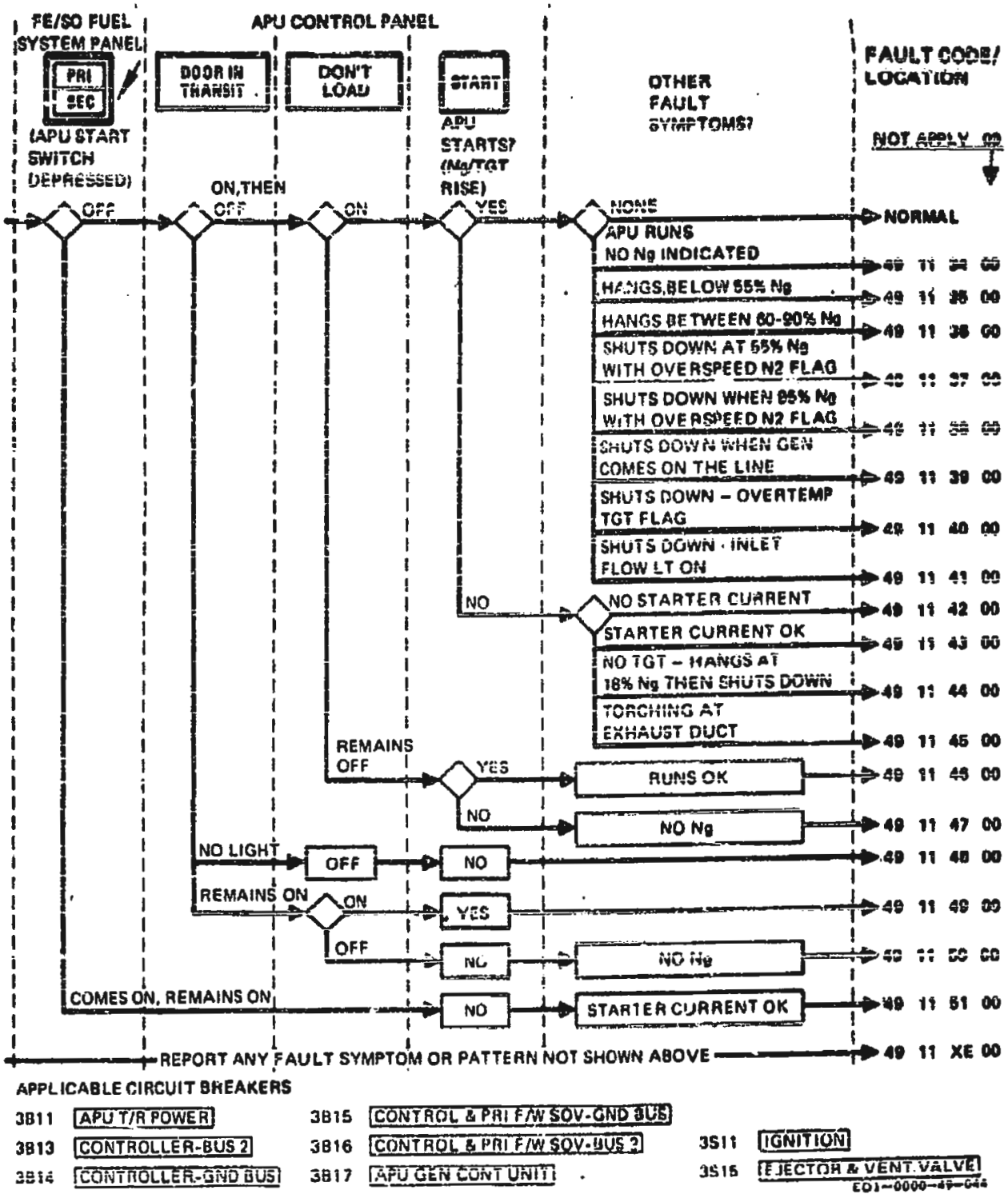
APU Pre-Start - Fault Codes
Figure 3

EFFECTIVITY: ALL

49-FAULT CODE DIAGRAM



APU Normal Shutdown - Fault Codes
Figure 4



R APU Start - Fault Codes
Figure 5

R EFFECTIVITY: ALL

49-FAULT CODE DIAGRAM

FAULT CODE INDEX
TABLE 1

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
49 11 XA 00	1. An APU Operation fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Fault Code diagram for flight crew actions.)
R R	2. 49-11-00 Fig. 114, 120, 121, 122, 123, 124, 126, 127, 130, 131 Block 1
49 11 XB 00	1. An APU Auto Shutdown fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Fault Code diagram for flight crew actions.)
R R	2. 49-11-00 Fig. 115, 116, 117, 118, 131 and 135 Block 1
49 11 XC 00	1. An APU Pre-Start fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Fault Code diagram for flight crew actions.)
	2. 49-11-00 Fig. 103, 112 and 119 Block 1
49 11 XD 00	1. An APU Normal Shutdown fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Fault Code diagram for flight crew actions.)
	2. 49-11-00 Fig. 125, 133 and 134 Block 1
49 11 XE 00	1. An APU Start fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Fault Code diagram for flight crew actions.)
	2. 49-11-00 Fig. 104, 105, 106, 107, 108, 109, 110, 118, 128, 129, 131, 132 and 136 Block 1.

FAULT CODE INDEX
TABLE 1 (CONTINUED)

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
49 11 01 00	1. APU will not go into NORM mode; MAX mode OK. 2. 49-11-00 Fig. 124 Block 1
49 11 02 00	1. APU stays in MIN mode; MAX MODE light comes on. 2. 49-11-00 Fig. 124 Block 2
49 11 03 00	1. APU stays in MIN mode; MAX MODE light does not come on. 2. 49-11-00 Fig. 124 Block 2
49 11 04 00	1. APU does not go to MAX mode; NORM OK. MAX MODE light comes on. 2. 49-11-00 Fig. 120 Block 1
49 11 05 00	1. APU does not go to MAX mode; NORM OK. MAX MODE light does not come on. 2. 49-11-00 Fig. 120 Block 1
49 11 06 00	1. APU stays in NORM mode, with MIN mode selected. 2. 49-11-00 Fig. 126 Block 1
49 11 07 00	1. APU stays in MAX mode. 2. 49-11-00 Fig. 127 Block 1
49 11 08 00	1. NOT USED.
49 11 09 00	1. Low MAX MODE load compressor output Record: (preferable at engine start) Airport pressure altitude ___, outside air temp. ____, duct pressure ____, TGT ____, NG ____, KW Load ____. 2. 49-11-00 Fig. 114 (Sheet 1) Block 1

FAULT CODE INDEX
TABLE 1 (CONTINUED)

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
49 11 10 00	1. APU operating parameters (NG, TGT, duct pressure, generator frequency) fluctuate.
	2. 49-11-00 Fig. 130 Block 1
49 11 11 00	1. APU TGT erratic or lower than normal.
	2. 49-11-00 Fig. 131 Block 1
49 11 12 00	1. APU TGT higher than normal.
	2. 49-11-00 Fig. 131 Block 1
49 11 13 00	1. APU LOW OIL QUANTITY light on.
	2. 49-11-00 Fig. 121 Block 1
49 11 14 00	1. NOT USED.
49 11 15 00	1. BLEED AIR S/O OPEN light does not come on. No. 2 duct pressure indication; NORM mode operation OK.
	2. 49-11-00 Fig. 122 Block 10
49 11 16 00	1. BLEED AIR S/O OPEN light does not come on. No. 2 duct pressure indication but APU does not go to NORM mode.
	2. 49-11-00 Fig. 122 Block 3
49 11 17 00	1. BLEED AIR S/O OPEN light does not come on; no indication of No. 2 duct pressure.
	2. 49-11-00 Fig. 122 Block 5
49 11 18 00	1. BLEED AIR S/O OPEN light on with switch out.
	2. 49-11-00 Fig. 123 Block 1
49 11 19 00	1. BLEED AIR S/O OPEN light is slow going off.
	2. 49-11-00 Fig. 123 Block 3

FAULT CODE INDEX
TABLE 1 (CONTINUED)

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
49 11 20 00	1. APU shutdown. No fault flag; INLET FLOW light off. Fault repeats when APU restarted.
	2. 49-11-00 Fig. 118 Block 7
49 11 21 00	1. APU shutdown. No fault flag; INLFT FLOW light on. Fault repeats when APU restarted.
	2. 49-11-00 Fig. 118 Block 6
49 11 22 00	1. APU shutdown. APU FIRE PULL handle and FIRE lights on. Report if: (Main, Main and ALTN) fire bottle discharged.
	2. 49-11-00 Fig. 135 Block 1
49 11 23 00	1. APU shutdown with OVERTEMP TGT flag.
	2. 49-11-00 Fig. 131 Block 1
49 11 24 00	1. APU shutdown. HIGH TEMP OIL fault flag tripped.
	2. 49-11-00 Fig. 117 Block 1
49 11 25 00	1. APU shutdown. LOW PRESS OIL fault flag tripped.
	2. 49-11-00 Fig. 116 Block 1
49 11 26 00	1. APU shutdown from normal operating speed with OVERSPEED N2 flag tripped.
	2. 49-11-00 Fig. 115 (Sheet 1) Block 1
49 11 27 00	1. EMERGENCY SHUTOFF PRI light remains on when APU MASTER POWER switch latched in ON position.
	2. 49-11-00 Fig. 112 Block 1

FAULT CODE INDEX
TABLE 1 (CONTINUED)

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
49 11 28 00	1. AUTOFIRE SHUTDOWN ARMED light does not come on when APU MASTER POWER switch latched in ON position.
	2. 49-11-00 Fig. 103 Block 1
49 11 29 00	1. APU MASTER POWER switch does not latch in ON position.
	2. 49-11-00 Fig. 119 Block 1
49 11 30 00	1. AUTOFIRE SHUTDOWN ARMED and GEN OIL PRESS lights remain on when MASTER POWER switched off.
	2. 49-11-00 Fig. 125 Block 1
49 11 31 00	1. DOORS IN TRANSIT light does not indicate APU door closure.
	2. 49-11-00 Fig. 134 Block 5
49 11 32 00	1. DOOR IN TRANSIT light remains on when APU shut down.
	2. 49-11-00 Fig. 134 Block 2
49 11 33 00	1. APU does not shutdown when STOP switch is depressed.
	2. 49-11-00 Fig. 133 Block 1
R 49 11 34 00	1. No NG indication; APU starts and runs.
R	2. 49-11-00 Fig. 113 Block 2
R 49 11 35 00	1. APU hangs below 55% NG.
R	2. 49-11-00 Fig. 111 Block 1
R 49 11 36 00 R	1. APU hangs up or accelerates erratically between 60% and 90% NG.
R	2. 49-11-00 Fig. 128 Block 1

R EFFECTIVITY: ALL

0508

FAULT CODE INDEX
TABLE 1 (CONTINUED)

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
49 11 37 00	1. APU shuts down at 55% NG; OVERSPEED N2 flag tripped.
	2. 49-11-00 Fig. 115 (Sheet 1) Block 3
49 11 38 00	1. APU shuts down at 95% NG; OVERSPEED N2 flag tripped.
	2. 49-11-00 Fig. 115 (Sheet 2) Block 1
49 11 39 00	1. APU shuts down when APU generator comes on the line.
	2. 49-11-00 Fig. 136 Block 1
49 11 40 00	1. APU shuts down with OVERTEMP TGT flag tripped.
	2. 49-11-00 Fig. 131 Block 1
49 11 41 00	1. APU shuts down, INLET FLOW light on.
	2. 49-11-00 Fig. 118 Block 11
49 11 42 00	1. APU does not start; no starter battery current, DONT LOAD light on.
	2. 49-11-00 Fig. 109 Block 1
49 11 43 00	1. No Ng indication. Starter battery current OK, APU does not start.
	2. 49-11-00 Fig. 113 Block 5
49 11 44 00	1. APU does not light off; hangs at 18% NG, then shuts down.
	2. 49-11-00 Fig. 110 Block 1
49 11 45 00	1. Torching at exhaust duct during APU start.
	2. 49-11-00 Fig. 131 Block 5

FAULT CODE INDEX
TABLE 1

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
R 49 11 46 00	1. DONT LOAD light does not come on. APU starts and runs.
R	2. 49-11-00 Fig. 107 Block 1
R 49 11 47 00	1. APU does not start (no NG); DOOR IN TRANSIT light OK, DONT LOAD light does not come on.
R	2. 49-11-00 Fig. 108 Block 1
R 49 11 48 00	1. APU does not start. No DOOR IN TRANSIT light; DONT LOAD light does not come on.
R	2. 49-11-00 Fig. 104 Block 1
R 49 11 49 00	1. DOOR IN TRANSIT light remains on; APU starts and runs.
R	2. 49-11-00 Fig. 106 Block 1
R 49 11 50 00	1. APU does not start. DOOR IN TRANSIT light remains on; DONT LOAD light does not come on.
R	2. 49-11-00 Fig. 105 Block 1
R 49 11 51 00	1. APU cranks but does not start; EMERGENCY SHUTOFF SEC light remains on.
R	2. 49-11-00 Fig. 129 Block 1

AIRBORNE AUXILIARY POWER - DESCRIPTION AND OPERATION

1. General

An airborne auxiliary power system (Ref. Fig. 1) consisting of an auxiliary power unit (APU) and its associated components provides the aircraft with a self-contained source of electrical and pneumatic power. Although intended primarily for ground operations, the system may be operated in-flight to provide a secondary back-up power source for the electrical power system, and a pneumatic power source for air-operated components.

The airborne auxiliary power system includes the following components:

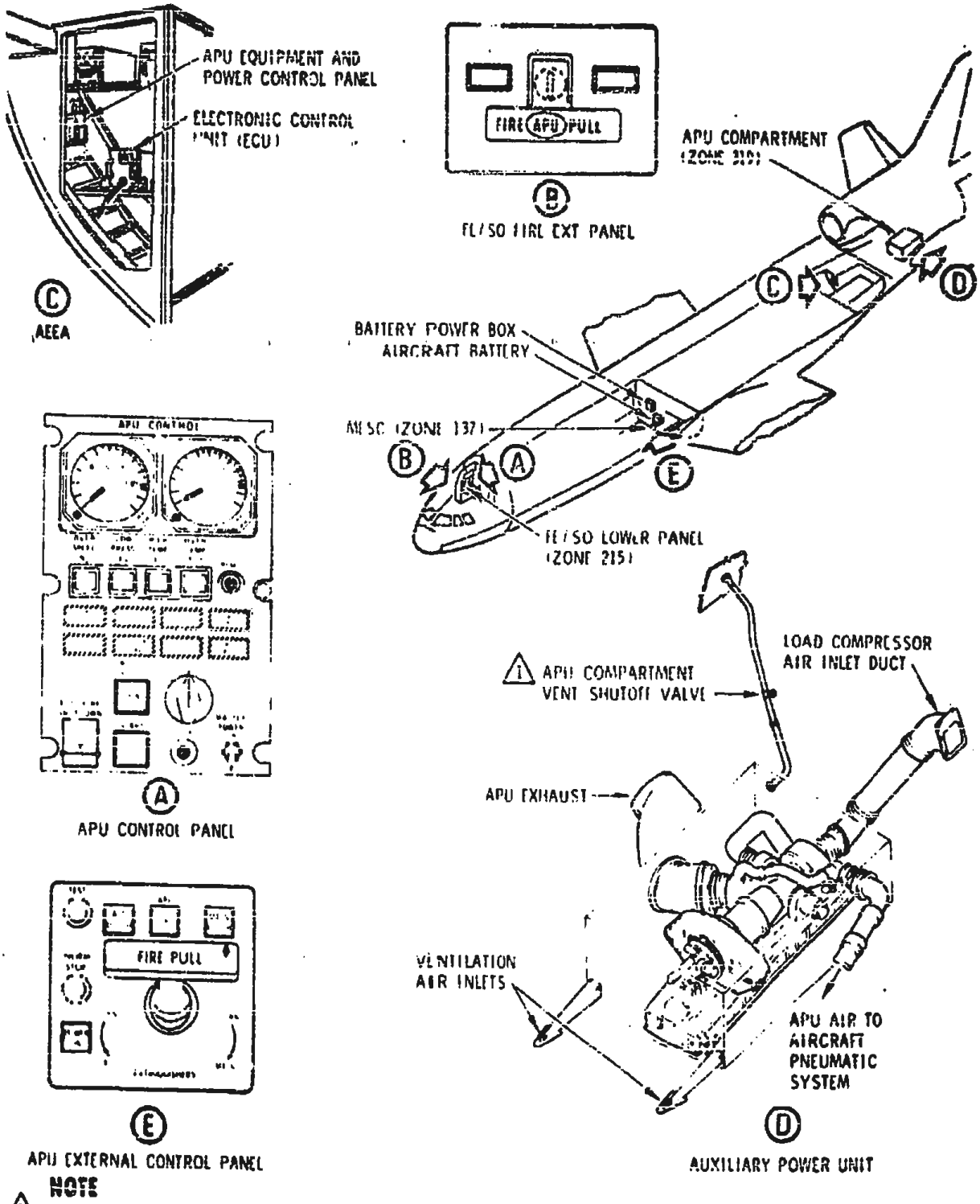
A. Auxiliary Power Unit (APU)

The APU is a self-contained power plant consisting of a turbo-shaft gas turbine engine, a load hardware gearbox, and associated power plant accessories. Power is extracted from the engine by an engine exhaust gas driven free power turbine and transmitted through the gearbox to an air load compressor, an engine cooling air fan, and an ac electrical generator.

The APU is installed in a compartment located in the forward lower part of the aircraft afterbody structure and is electrically controlled and governed by a remotely located electronic control unit (ECU).

The APU is a self-contained unit requiring only fuel from the aircraft fuel distribution system and the aircraft battery for operation. It is placed in operation by closing an APU master power switch and momentarily depressing a start switch on the Flight Engineer/Second Officers APU control panel. Indicators on the panel are then monitored to assure proper acceleration of the unit to a stabilized operating condition. Normal shutdown is initiated by depressing an APU stop switch button and switching off master power after the panel indicators indicate completion of the automatic shutdown sequence.

Provisions are incorporated that permit unattended operation of the unit. These provisions include automatically initiated shutdown cycles for high oil temperatures, high turbine temperatures, free turbine overspeed, and a low oil pressure condition exceeding 10 seconds. Automatic shutdown of the unit is also initiated by an APU compartment fire warning circuit and a differential pressure switch which monitors inlet air flow to the APU powered air compressor.

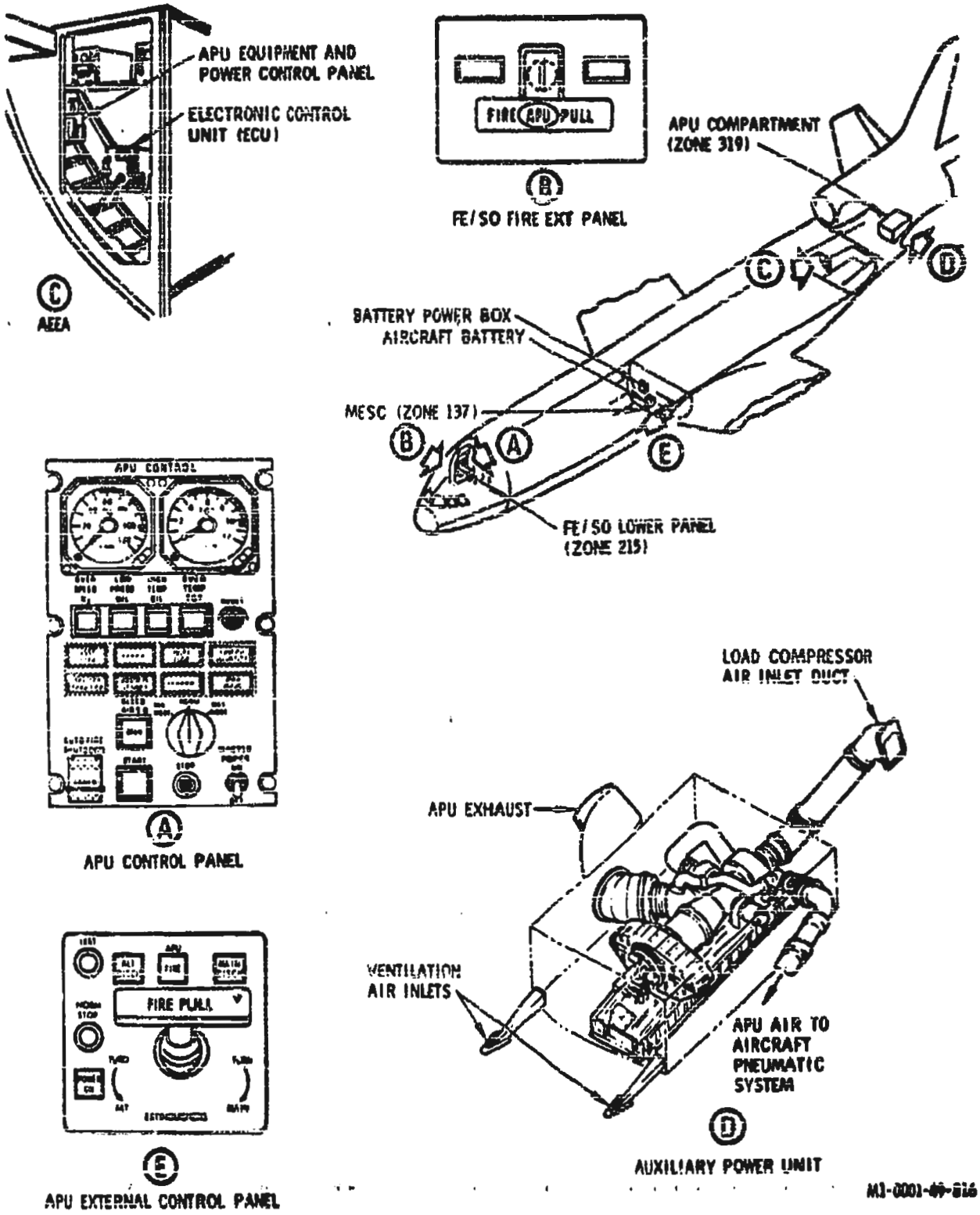


1 NOTE
ELECTRICALLY DEACTIVATED AND WIRED CLOSED

M1-0030-49-1044

R
R

Airborne Auxiliary Power System
Figure 1



M1-0001-49-816

Airborne Auxiliary Power System
Figure 1

A manual shutdown following a fire warning indication is initiated by pulling one of two fire pull handles, one on the Flight Engineer/Second Officers panel and the other on an external APU control panel.

The basic APU control system criteria is based on a sharing of the available APU engine power between the pneumatic and electrical loads applied to the unit. The APU driven generator output frequency is dependent on a constant generator rpm and must be maintained within a strict tolerance range of ±5%. Since the generator is essentially directly driven by the free turbine, the APU control system is primarily directed towards keeping a constant free turbine speed under all operating conditions and loads. The importance of maintaining generator frequency therefore imposes a requirement that the generator be given priority over available engine power at all times the generator is on the line.

Automatic control of the APU is accomplished by interfacing the electronic control unit (ECU) with the engine fuel control system, load compressor, and generator. In order to exercise this control, the ECU is dependent on an operational interface with the following components (Ref. Fig. 2):

Free Turbine Speed Controller

Load Compressor Controller

Free Turbine Speed Sensors

Gas Generator (Ng) Tachometer

Inlet Guide Vane Position Transducer

Current Transformer

Compressor Air Inlet Temperature Sensor

Compressor Mode Select Switch

High Oil Temperature Sensing Switch

Low Oil Pressure Sensing Switch

Engine Temperature Sensing Harness

Vent Ejector Door Actuator

R APU Master Power Switch

APU START and STOP switches

Load Compressor Air Inlet Differential Pressure Switch

B. APU Electronic Controller

The APU electronic control unit (ECU) (Ref. Fig. 3) is contained in a 3/4 short ATR box mounted on the equipment
R rack in the aft electronic equipment area (Ref. Fig. 1). The ECU contains the sequencing, constant speed/load control, and automatic shutdown control circuitry which interact to automatically control APU operation. The ECU is described in further detail in Section 49-61-00.

C. APU Control Panel

The APU control panel (Ref. Fig. 1 and 4) is installed in the Flight Engineer/Second Officers lower instrument panel. It supports the APU gas generator (Ng) and turbine gas temperature (TGT) indicators, an array of APU status advisory lights, four fault shutdown indicators, an APU load compressor mode select switch, and the switches used to initiate an APU start and shutdown cycle.

D. APU External Control Panel

An APU external control panel (Ref. Fig. 4) is located in the belly of the aircraft at FS 1035 just aft of the ECS air inlets. The panel contains the control switches for a normal or emergency shutdown of the APU at ground level and, if necessary, the release of fire extinguishing agent into the APU compartment.

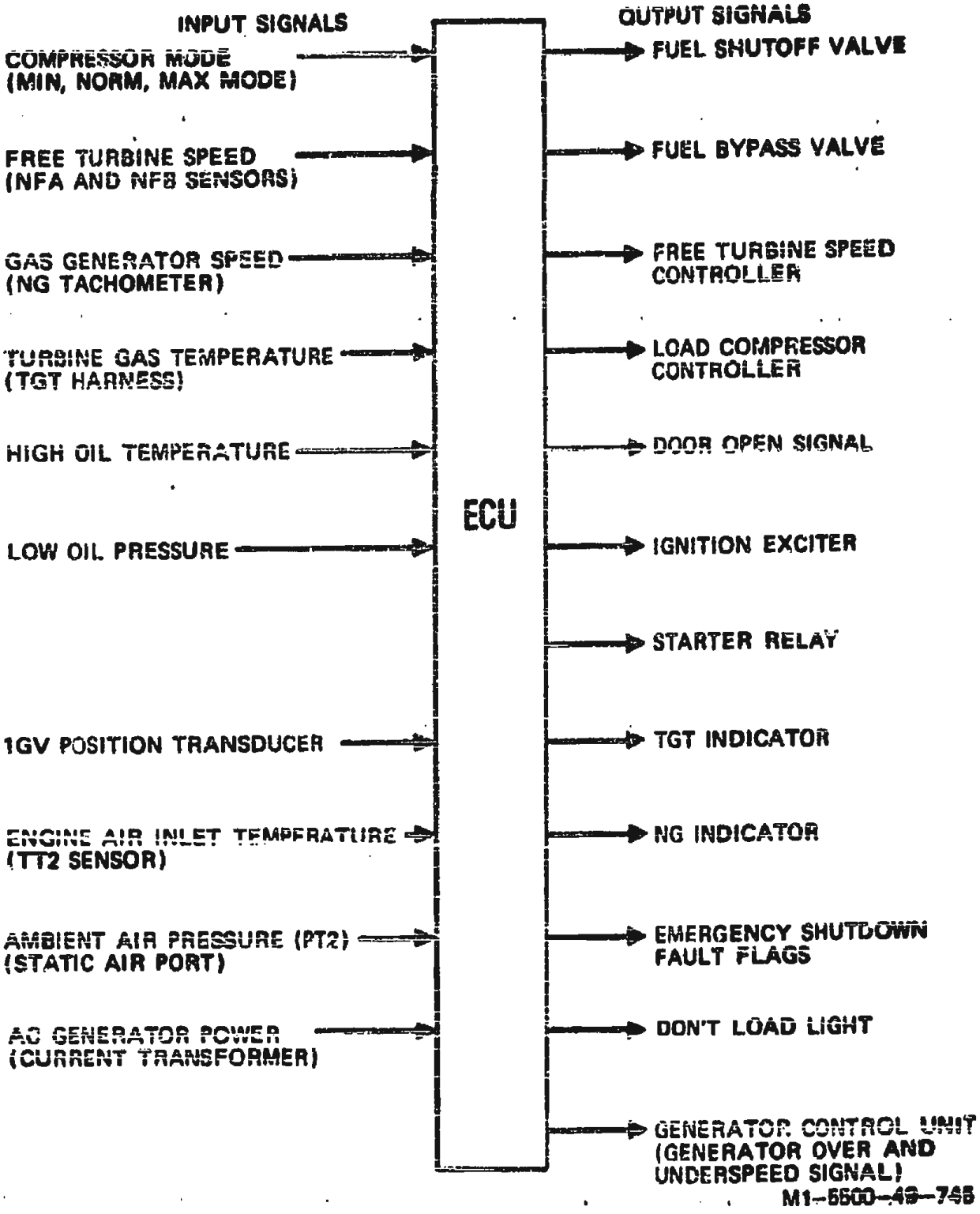
E. APU Equipment and Power Control Panel

The APU equipment and power control panel (Ref. Fig. 1) is
R located in the aft electronic equipment area next to the electronic controller. It supports the majority of the aircraft control circuit relays and remote control circuit breakers associated with APU operation exclusive of the auto fire shutdown, fuel control, and power control relays located in the mid electrical service center.

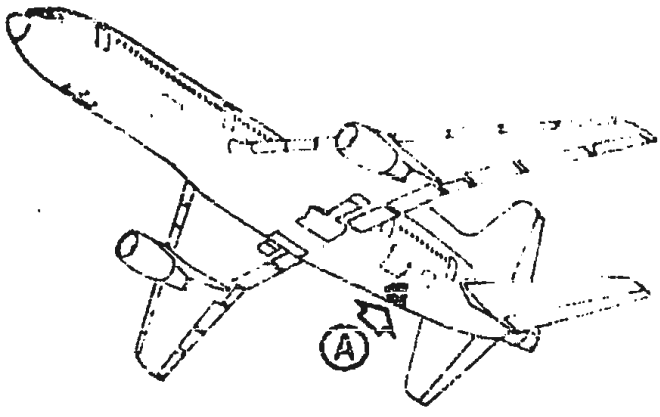
F. Aircraft Battery

The aircraft battery is installed in the mid electrical service center (Ref. Fig. 1). Although not primarily an APU system component, aircraft battery power is required for APU operation.

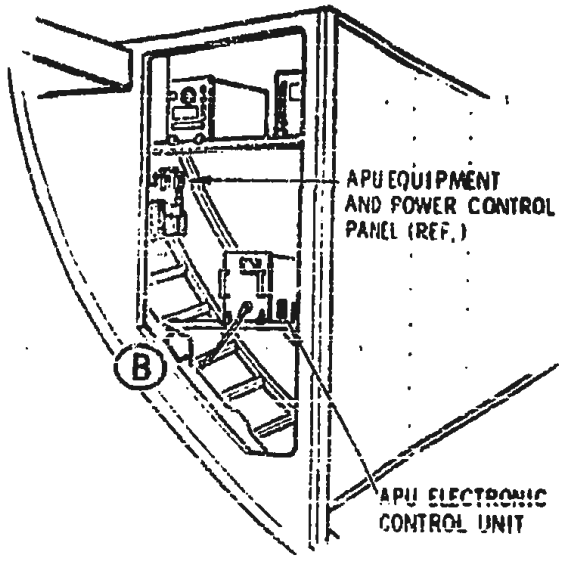
G. Battery Power Box



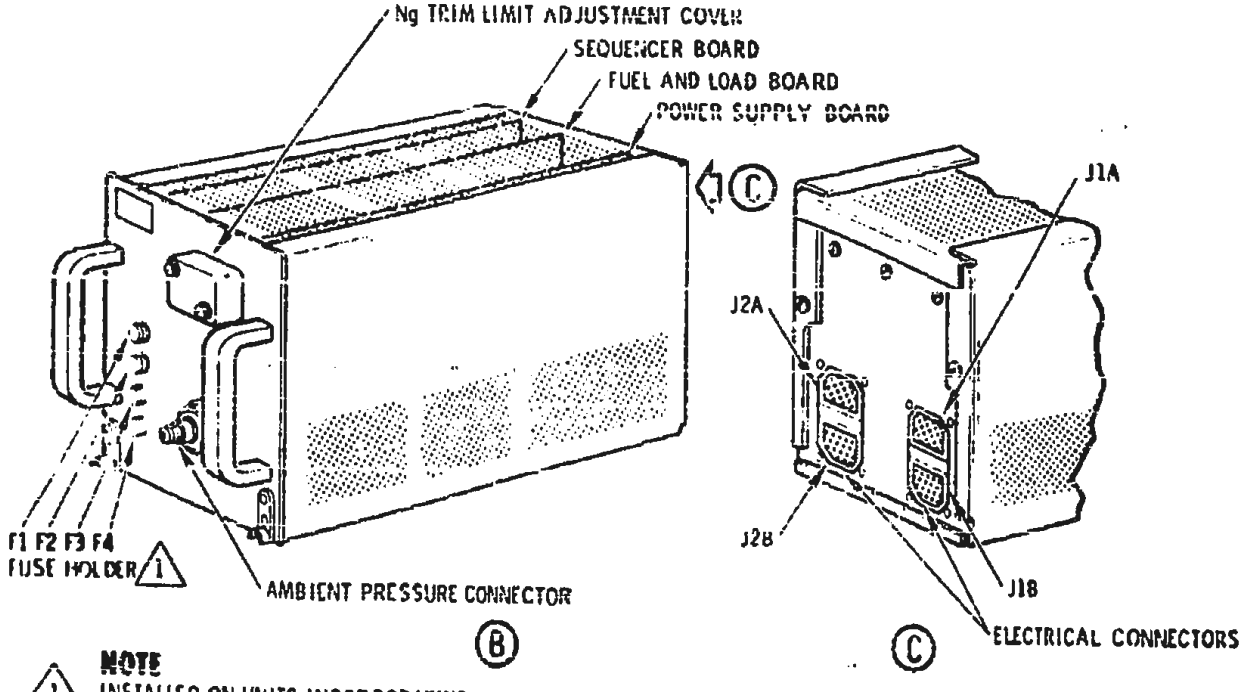
R R ECU Signal Flow Diagram
Figure 2



ZONE 164



(A)
AFT ELECTRONIC EQUIPMENT AREA

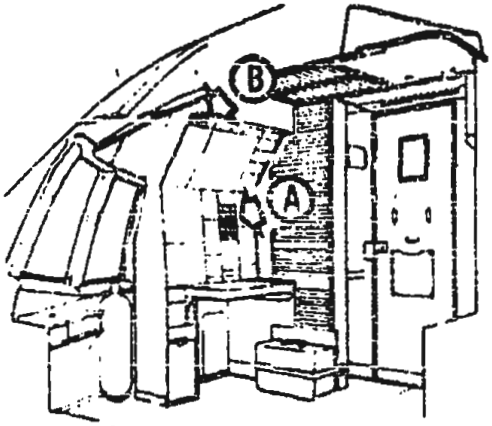


1 **NOTE**
INSTALLED ON UNITS INCORPORATING SERVICE BULLETIN HS49-158

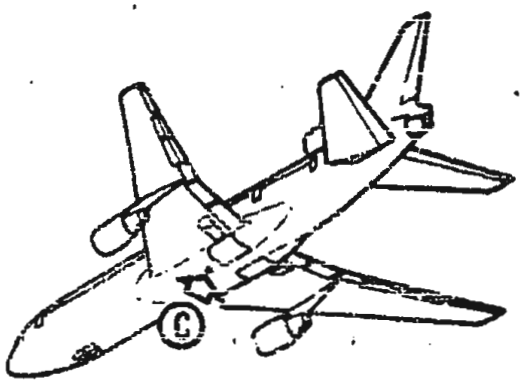
M1-0000-49-1040

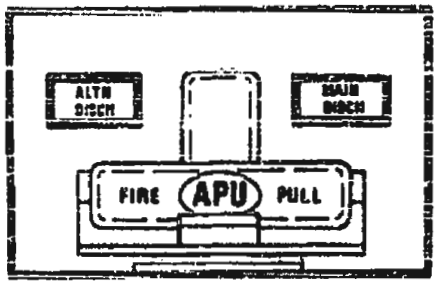
R APU Electronic Control Unit (ECU)
R Figure 3

EFFECTIVITY: ALL

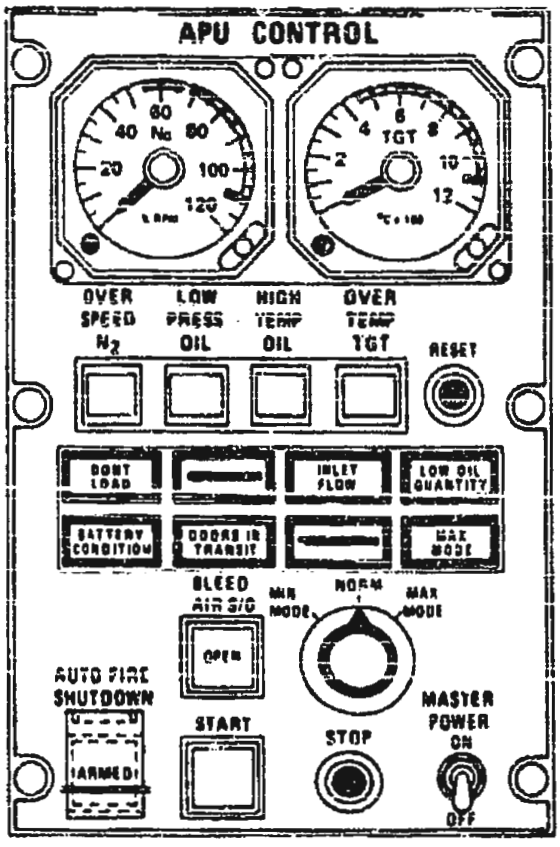


FLIGHT ENGINEER/SECOND OFFICERS STATION
ZONE 215

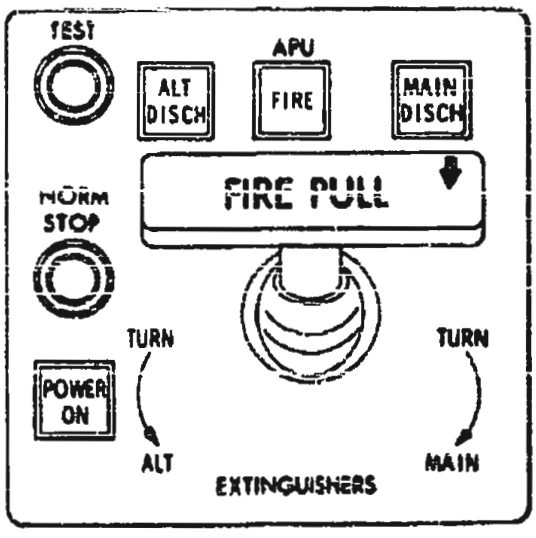




B



A



C

MI-0000-49-020

R
R

APU Control Panel
Figure 4

The battery power box is mounted on the aft bulkhead of the MESC. The box houses the battery power remote control circuit breakers, starter current limiter, and APU power transfer relay associated with the application of battery power to the APU control circuits.

2. APU Power Plant

A. Description

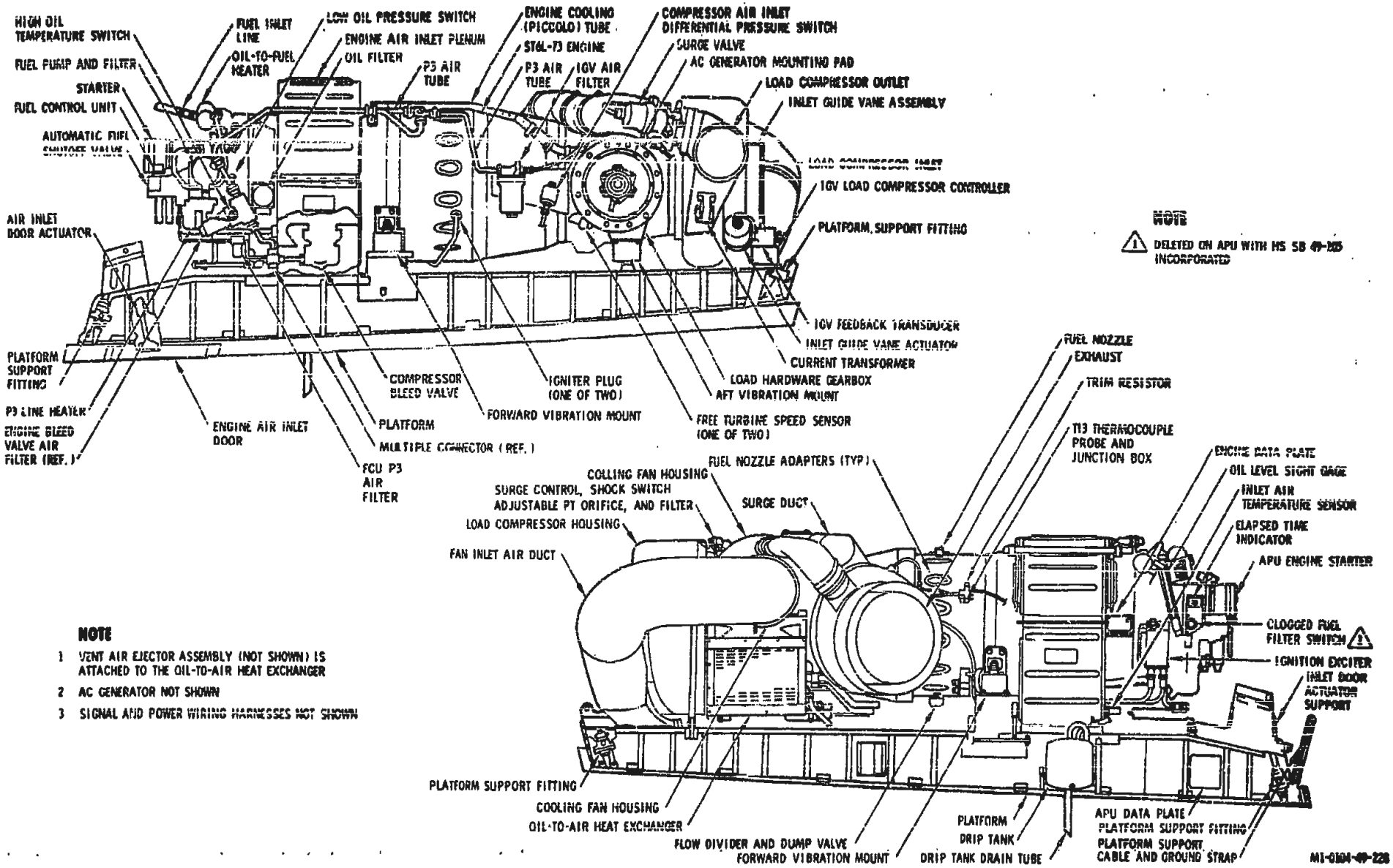
The APU power plant (Ref. Fig. 5) is a complete modular unit consisting of the APU engine, an integral free turbine driven load hardware gearbox, and air load compressor and inlet guide vane assembly, a 90 KVA ac generator, and the associated accessories and sub-system components required to support power plant operation. The unit is mounted on a platform in a compartment located in the lower forward portion of the aircraft afterbody section. When installed, the platform closes off the central portion of the compartment access area with the platform lower surface conforming to the afterbody contour. Two hinged access doors arranged in tandem on each side of the platform provide access to the installed APU.

The APU power plant uses a modified ST6L-73 turboshaft gas turbine engine having an integral compressor and turbine spool and a reverse flow annular combustion chamber. Power is extracted from the hot engine exhaust gasses by the free turbine and transmitted through the gearbox to drive the air load compressor, engine cooling air fan, and ac generator. The engine thus serves only as a gas generator, developing the hot gasses used to drive the free turbine, and is in no way mechanically connected to the load hardware gearbox or free turbine.

Engine power output (up to the max trim limit) is reflected in the speed of the engine compressor/turbine spool (Ng) and is controlled by the ECU at a level that will maintain the free turbine at the constant 33,000 rpm necessary for proper operation of the ac generator. APU power plant general specifications are listed in Table 1. The APU power plant is described in detail in Section 49-11-00. The APU power plant control system is described in detail in Section 49-61-00.

APU Power Plant General Specifications
Table 1

SPECIFICATION	VALUE
APU Size (approximate)	Length 92 inches, width 52 inches, height 31 inches
APU Platform Size	30 inches by 90 inches
APU Weight with Platform (approximate)	720 pounds (less generator)
Power plant designation	ST6L-73
Horsepower	635 at sea level, 103°F
Free Turbine Speed Nf (100%)	33,000 rpm (constant)
Gas Generator Speed Ng (100%)	37,500 rpm
Ng Electronic Topping Range	36,500 - 38,100 rpm (97 to 101.6 percent)
Ng Governor Flyweight Topping	38,500 - 38,850 rpm
Fuel Flow	400 lb/hr at 100 percent load at sea level, 103 degrees F
Load Compressor Speed	33,000 rpm (constant)
Load Compressor Output	385 lbs/min at 41 psia at 103 degrees F, sea level with 45 KW electric load
Comp Discharge Air Temp	360°F at 103 degrees F day
Cooling Fan Speed	32,869 rpm
Cooling Fan Output	160 lbs/min at sea level at 103 degrees F day
Generator Speed	12,000 rpm
Generator Output	90KW, 3 phase, 400 Hz



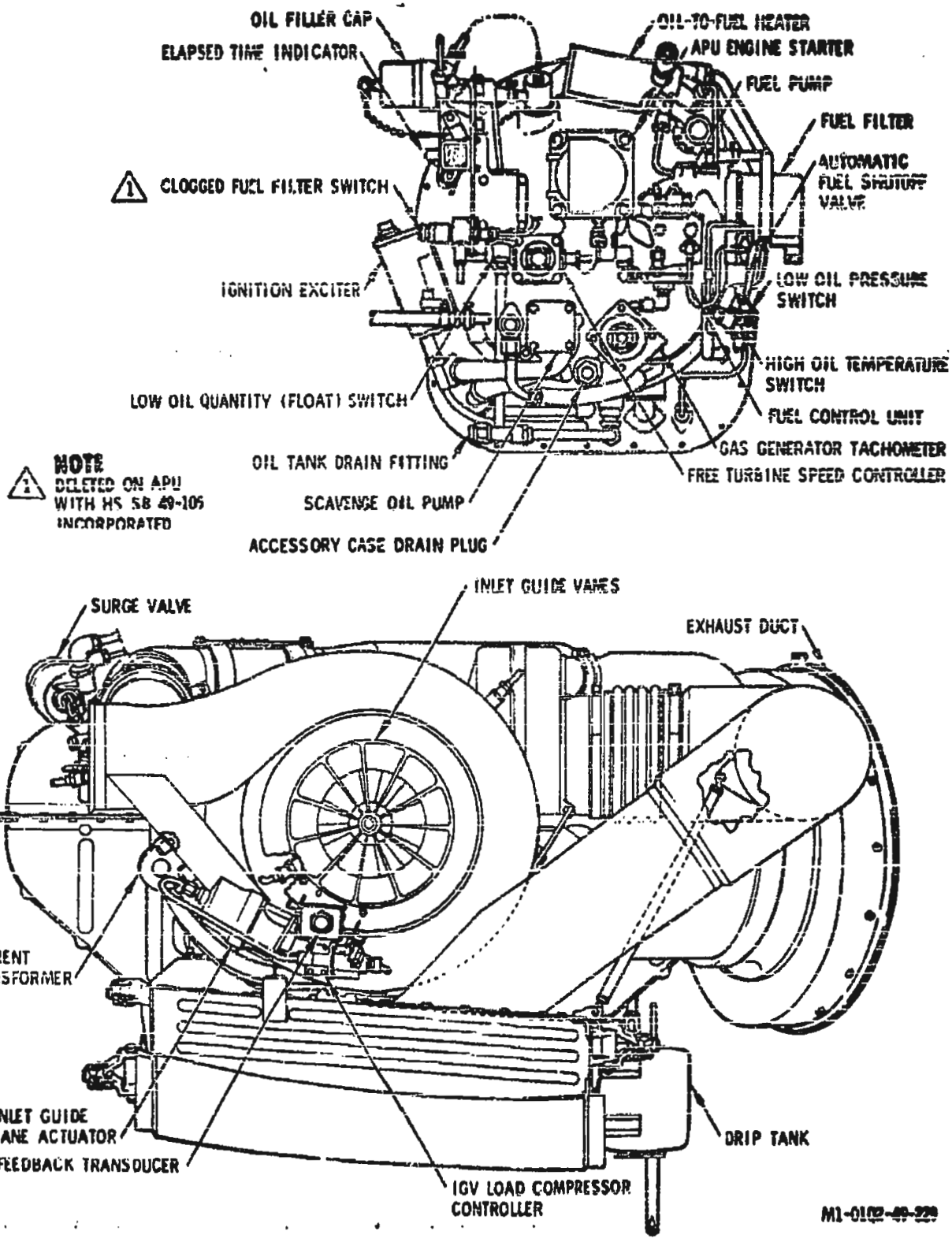
NOTE

1 VENT AIR EJECTOR ASSEMBLY (NOT SHOWN) IS ATTACHED TO THE OIL-TO-AIR HEAT EXCHANGER

2 AC GENERATOR NOT SHOWN

3 SIGNAL AND POWER WIRING HARNESSES NOT SHOWN

APU Power Plant
Figure 5 (Sheet 1)



APU Power Plant
Figure 5 (Sheet 2)

3. Engine

A. Description and Operation

The APU engine (gas generator) (Ref. Fig. 6) consists of a four-stage compressor spool (coupled to a single-stage compressor turbine), a reverse flow annular combustion chamber, and an independently supported single-stage free power turbine. The first three stages of compression are axial; the fourth is a centrifugal flow radial impeller.

The free power turbine is directly coupled to and drives the load hardware gearbox. An accessory drive gearbox at the forward end of the engine is driven by the compressor spool.

In operation, air drawn into the engine from the APU platform and air inlet plenum flows through the compressor into the combustion chamber where it picks up the heat energy in the burning fuel/air mixture. The hot expanding gasses developed in the combustion chamber expand to the atmosphere through the compressor and free power turbines and an air cooled exhaust duct. Energy extracted from the gasses is used by the respective turbines to drive the compressor spool and load hardware gearbox.

Proper functioning of the ac generator requires that the free power turbine be maintained at a constant 33,000 rpm. This must be done under varying loads placed upon the generator and air load compressor. Fuel flow to the engine is therefore constantly regulated so that engine power output is always at a level sufficient to maintain free power turbine speed at 33,000 rpm.

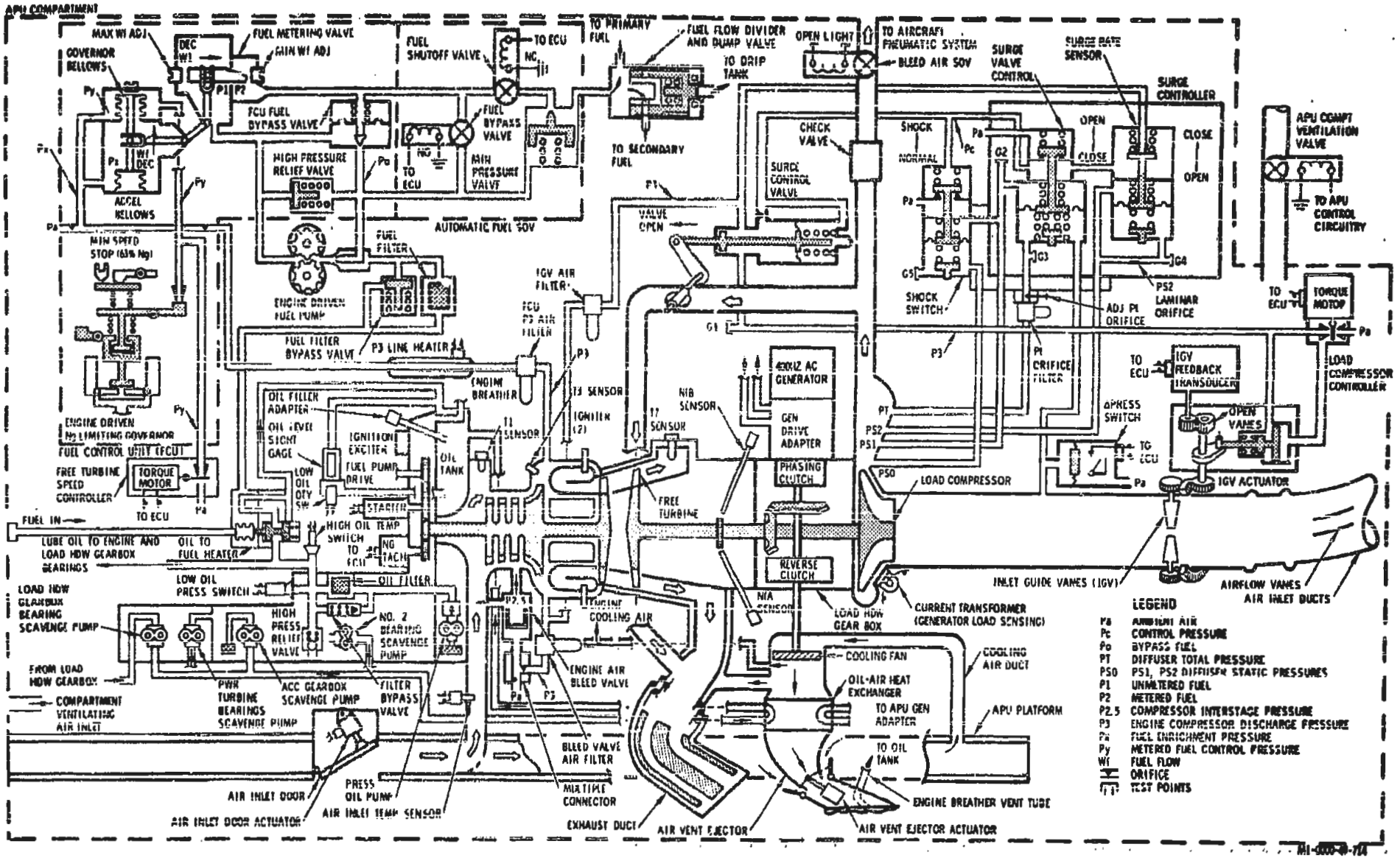
The APU engine and its accessories are described in detail in Section 49-21-00.

4. Engine Fuel and Control

A. Description and Operation

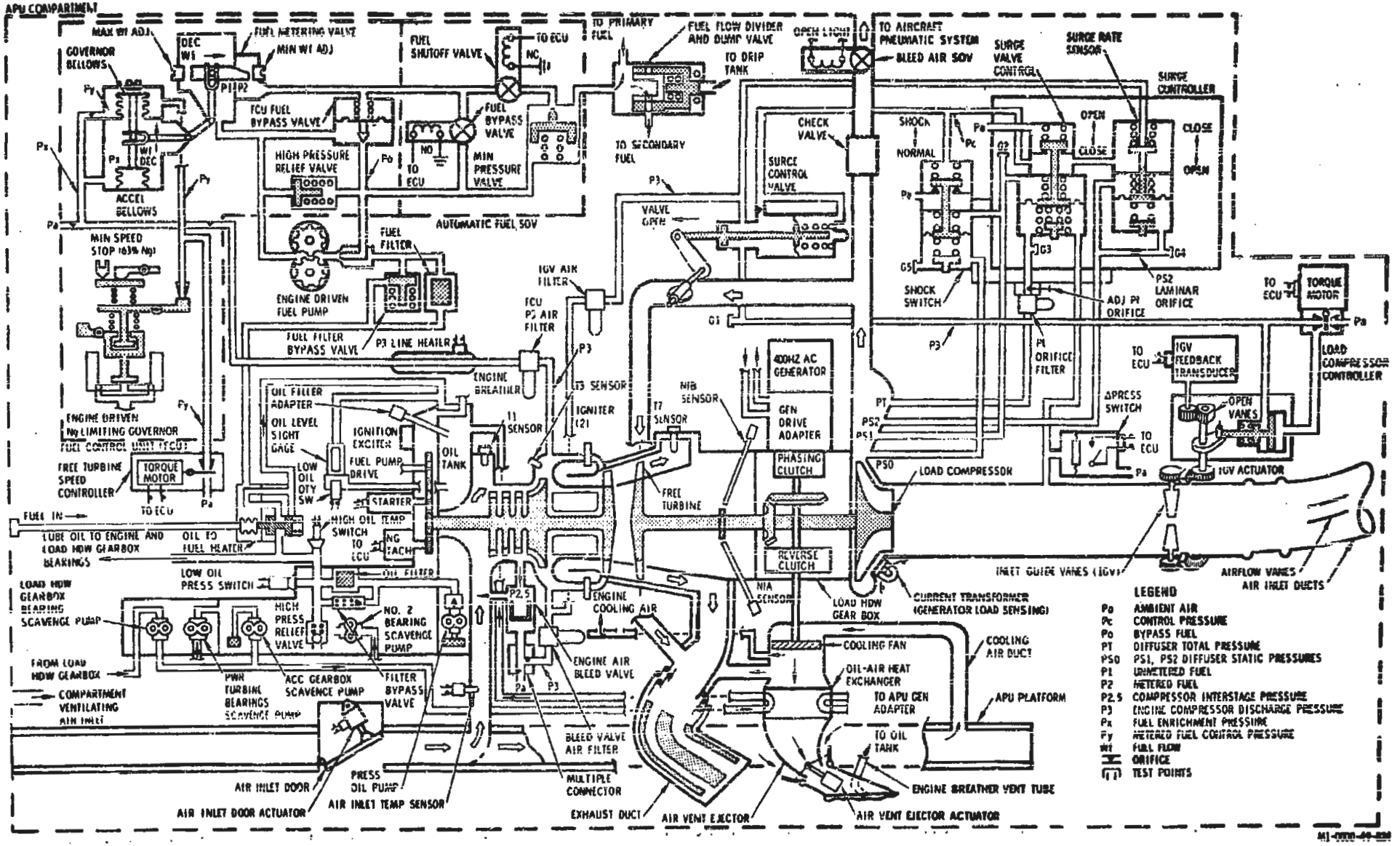
Fuel is supplied to the APU through primary and secondary emergency fuel shutoff valves and a flexible fuel hose connected to a fitting in the No. 2 engine fuel feed line. The primary fuel shutoff valve is normally closed and is opened when APU master power is applied. The secondary fuel shutoff valve is normally open. Both valves are closed by the automatic APU shutdown circuitry or by actuation of the APU fire pull handles.

Fuel enters the APU engine through an oil-to-fuel heat exchanger and a filter to the engine driven fuel pump. From



APU Power Plant Diagram
Figure 6

R EFFECTIVITY: 001-031
R
0018



APU Power Plant Diagram
Figure 6

R EFFECTIVITY: 032-999
R
001B

the pump, fuel flows to a fuel control unit where it is metered in accordance with the power demanded from the engine and directed through an automatic fuel shutoff valve assembly and a flow divider/dump valve to the fuel injector manifold.

Engine power output is a direct function of the authority that the electronic controller (ECU) exercises over the free turbine speed controller in controlling the amount of fuel supplied to the engine by the fuel control unit.

The APU fuel and control system is described in further detail in Section 49-31-00.

5. Ignition and Starting

A. Description and Operation

Motoring of the APU during the initial stages of an APU start cycle is accomplished by an electrically operated direct drive starter. Starter operation is controlled by an electronic timer in the ECU. If the APU fails to light off and accelerate to 55 percent Ng before the timer lapses, the ECU automatically shuts down the APU.

Ignition of the fuel-air mixture in the APU combustion chamber is initiated by an ECU controlled ignition exciter unit and two igniters. Ignition is terminated by the ECU after the APU has accelerated to 55 percent Ng and combustion is self-sustaining.

Ignition and starter systems are described in further detail in Section 49-41-00.

6. Air

A. Description and Operation

R Air used for supporting combustion in the APU engine and for engine cooling is admitted to the APU platform through a (fixed open) air inlet door located in the forward lower surface of the platform (Ref. Fig. 6). Approximately two thirds of the airflow into the platform is drawn into the engine by the gas generator to support combustion and develop the hot expanding gasses used to drive the gas generator turbine. These gasses are expelled through the engine exhaust system. The remaining one third is drawn from the platform by the engine cooling fan. A portion of this air is used to cool the exhaust system and external surfaces of the gas generator section. The remaining

portion is directed through the engine oil-to-air heat exchanger core and expelled overboard through the air vent ejector assembly.

APU compartment ventilating air enters the compartment through two NASA type scoops located in the lower fuselage surface just forward of the platform and leaves the compartment through the air vent ejector doors.

APU load compressor air is drawn into the aircraft through an opening in the upper left surface of the afterbody section and through a duct to the load compressor air inlet. The amount of air entering the compressor is determined by the position of the ECU controlled variable inlet guide vanes at the compressor inlet. Pressurized airflow from the compressor is directed into a duct and routed through a multiple petal type check valve and bleed air shutoff valve into the aircraft pneumatic system ducting.

In order to maintain compressor loading and prevent the surging or stalling incurred by sudden changes in compressor airflow demands, varying amounts of compressor output airflow are diverted through a surge control valve into the engine exhaust.

APU air and airflow control systems are described in further detail in Section 49-51-00.

7. Engine Controls

A. Description and Operation

APU engine operation is electrically controlled by the electronic control unit (ECU) which responds to inputs from ambient air temperature and pressure sensors, a free turbine speed sensor, and an electrical load sensing transformer to regulate engine power output. It does this through a free turbine speed controller which indirectly controls the amount of fuel metered to the engine by the fuel control unit. Except for the aircraft electrical control circuits used to initiate APU starting and shutdown, the sequencing of events which start and stop engine operation, and the regulation of engine power output to meet electrical and air load system demands, is an entirely automatic function performed by the ECU.

The engine control system is integrated with the electrical system that controls operation of the complete APU power plant system and is described in detail in Section 49-61-00.

8. Indicating

A. Description and Operation

Engine rpm (Ng) and TGT indicators are installed on the Flight Engineer/Second Officers APU control panel (Ref. Fig. 4).

The Ng indicator operates in conjunction with an Ng tachometer mounted on the APU engine accessory gearbox and the ECU to provide a flight station indication of APU engine compressor-turbine spool rpm.

The engine TGT (turbine gas temperature) observed on the APU control panel TGT indicator is a simulated turbine inlet temperature (T4) readout derived from a temperature sensing harness that encircles the engine to interconnect four temperature sensing probes and a trim resistor. The harness output signal is applied to the ECU which modifies it for internal use and applies it to the indicator.

Both indicators incorporate test buttons which when depressed drive the indicator pointers upscale to verify instrument operation. The TGT and Ng RPM indicating systems are described in further detail in Sections 49-71-00 and 49-75-00.

An elapsed time indicator (ETI) is mounted on a support bracket attached to the engine accessory gearbox. The indicator provides a digital readout of accumulated engine operating time. The ETI indicator is described in further detail in Section 49-61-01.

9. Exhaust

A. Description and Operation

Engine exhaust gasses are conducted to the atmosphere through an exhaust duct assembly consisting of a concentric diffuser and a sound attenuating muffler. Cooling air from the APU cooling air fan flows through the annular area between the inner and outer ducts of the diffuser. The exhaust system is described in further detail in Section 49-81-00.

10. Oil

A. Description

Engine lubricating oil is contained in a tank which is an integral part of the engine compressor inlet air case. An oil filler neck containing a pressure fill adapter and an oil level sight gage is provided for checking oil quantity and replenishing the oil supply. An oil filter is housed in a cavity machined in the side of the compressor case.

APU engine oil pressure is sensed by a low oil pressure switch. If engine oil pressure drops below 57 (±2.5) psi, the ECU will (after a 10-second delay) initiate an automatic APU shutdown and trip a LOW PRESS OIL fault flag on the APU control panel.

A low oil quantity sensing switch illuminates the LOW OIL QUANTITY light legend on the APU control panel whenever the oil in the tank is approximately 3.5 quarts below the normally serviced full level.

The low oil quantity indicating light circuit functions only when the aircraft is on the ground.

Engine oil is cooled in a dual oil-to-air heat exchanger containing two thermostat controlled bypass valves. One-half of the unit is used to cool engine oil; the other half the generator adapter lubricating oil. Heat is conducted away from the heat exchanger core by cooling fan air which flows overboard through the heat exchanger core and compartment air vent ejector.

The engine lubricating oil system is described in further detail in Section 49-91-00.

AUXILIARY POWER UNIT (APU) - MAINTENANCE PRACTICES

1. General

The following method is used to deactivate an inoperative auxiliary power unit (APU) and to secure the APU Bleed Air Shutoff Valve in the closed position.

2. Deactivation

NOTE: This deactivation procedure applies only when an aircraft is to be dispatched in accordance with the MEL.

A. Deactivation Procedure

C (1) On Flight Engineer/Second Officers aft circuit breaker C panel CB3, open and collar circuit breakers POWER C CONTROL (S13) and CONT POWER (S12).

(2) Apply APU master power. If VENT CLOSED light comes on, C verify that it goes out (APU compartment ventilation valve must be open).

(3) Place MASTER POWER switch to OFF position.

C (4) On Flight Engineer/Second Officers aft circuit breaker C panel CB3, open and collar circuit breakers APU BLEED C AIR VALVE (S18) for aircraft 11001-21023.

C (5) On Pilots overhead circuit breaker panel CB1, open and C collar circuit breaker APU BLEED AIR VALVE (H13) for C aircraft 21024-31036.

C (6) Install appropriate APU INOPERATIVE placard in the C flight station at location clearly visible to the C flight crew.

(7) Make appropriate entry in aircraft log book.

C NOTE: APU inlet door may be inoperative in any C position.

CR 3. Reporting an APU Inoperative

CR A. When an APU becomes inoperative and must be placarded, the CR Maintenance Coordinators at MCI (MCIMD) must be advised.

CR B. MCIMD, also, will want to know what is wrong with the APU.
CR A simple "INOP" is not acceptable. In order to get the APU
CR back into service as soon as possible, more specific
CR symptoms are needed. Small bits of information can save a
CR lot of guesswork and time.

CR C. The following list is a guideline for things to look for.
CR These are general items and may not apply to all APU types.

CR (1) Start Problems

CR Did inlet door operate?

CR Did crank light come on?

CR Did battery voltage drop/amperage draw indicate?

CR Was there fuel and/or ignition?

CR Was there any EGT indication?

CR Was there overspeed shutdown and at what speed?

CR EICAS message/BITE check on ECU?

CR What was RPM indication?

CR (2) Hung Start/Shutdowns

CR What was the EGT indication?

CR What was the RPM indication?

CR Did the crank light go out?

CR Did any flags show?

CR EICAS message/BITE check on ECU?

CR Was shutdown at engine start valve closure?

CR Was shutdown during aircraft or APU power changeover?

CR (3) Load Problems

CR Is air okay - no electric?

CR Is electric okay - no air?

CR If not electric - what is frequency and voltage
CR indication?

CR Will field close?

CR If low air - What is manifold pressure? What is vane
CR or valve position?

CR (4) What is EGT indication?

CR Does APU speed droop?

CR Does the APU have fluctuating parameters?

CR EICAS message/BITE check on ECU?

AUXILIARY POWER UNIT (QEC) - REMOVAL AND INSTALLATION

1. Equipment and Materials

Closure Kit, HS P/N GS14786-1, or equivalent (Ref. G/ITEL 49-00-15) APU QEC, 1520440-( )

Portable Hoist (3 required), PF Industries P/N PF51-011, or equivalent (Ref. G/ITEL 49-00-06)

Left Hoist Adapter, PN BA22-101, or equivalent (Ref. G/ITEL 49-00-02)

Right Hoist Adapter, PN BA23-101, or equivalent (Ref. G/ITEL 49-00-03)

Aft Hoist Adapter, PN BA24-101, or equivalent (Ref. G/ITEL 49-00-04)

Hoist Spreader Assembly, PN BA25-101, or equivalent (2 required) (Ref. G/ITEL 49-00-01)

APU Support Dolly, GS 14100-1, or equivalent (Ref. G/ITEL 49-00-09)

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Antiseize Compound, MIL-T-5544, or equivalent

2. Referenced Procedures

	6-40-00	Exterior Access Doors and Panels
	12-12-41	Auxiliary Power Unit Oil Replenishing
	12-12-51	Auxiliary Power Unit Generator Oil Replenishing
	12-21-46	Auxiliary Power System Lubrication - APU Platform Mount
	24-24-01	APU Generator Assembly - Removal and Installation
	49-00-01	Airborne Auxiliary Power Unit (APU) - Adjustment and Test
R	49-00-02	Electronic Control Unit - Removal and Installation
	49-11-25	APU Compartment Insulation Blanket - Approved Repairs

49-21-01 APU Gas Turbine Engine - Servicing

49-51-19 Load Compressor Air Inlet Duct - Approved Repairs

3. Removal/Installation

A. Preliminary Procedures

R (1) Affix MAINTENANCE-IN-PROGRESS tags to FUEL SYSTEM and
R APU CONTROL panels.

R (2) At Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag APU POWER circuit
R breakers B9 through B17.

R (3) In zone 317, check position of manual override lever on
R APU primary emergency fuel shutoff valve actuator. If
R not in valve closed position, manually move lever to
R closed position.

R (4) In zone 317, position manual override lever on APU
R secondary emergency fuel shutoff valve actuator to the
R closed position.

B. Removal

(1) Position APU support dolly below APU compartment area, zone 319 (Ref. Fig. 401).

(2) Position maintenance stand under APU area.

(3) Place left, right, and aft hoist adapters, (BA 22-101, BA 23-101, and BA 24-101) on the maintenance stand.

(4) Install one hoist spreader assembly (BA 25-101) on each side of APU plenum structure (Ref. Fig. 401).

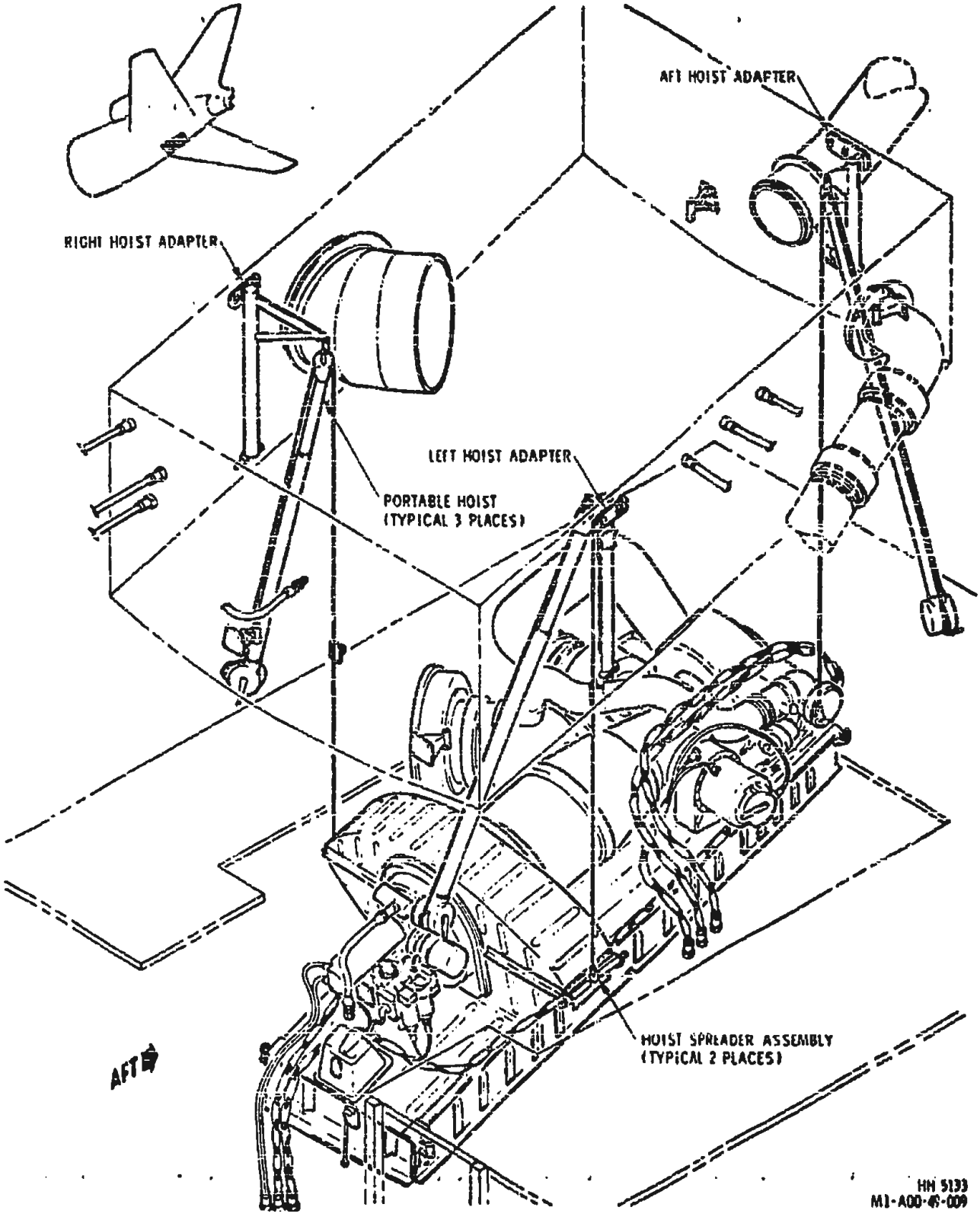
(5) Rotate hinged catcher section of fluid scupper installation forward and open APU compartment access doors 319AL, 319BR, 319CL, and 319DR (Ref. 6-40-00).

(6) At APU compartment forward bulkhead (FS 1885), perform the following:

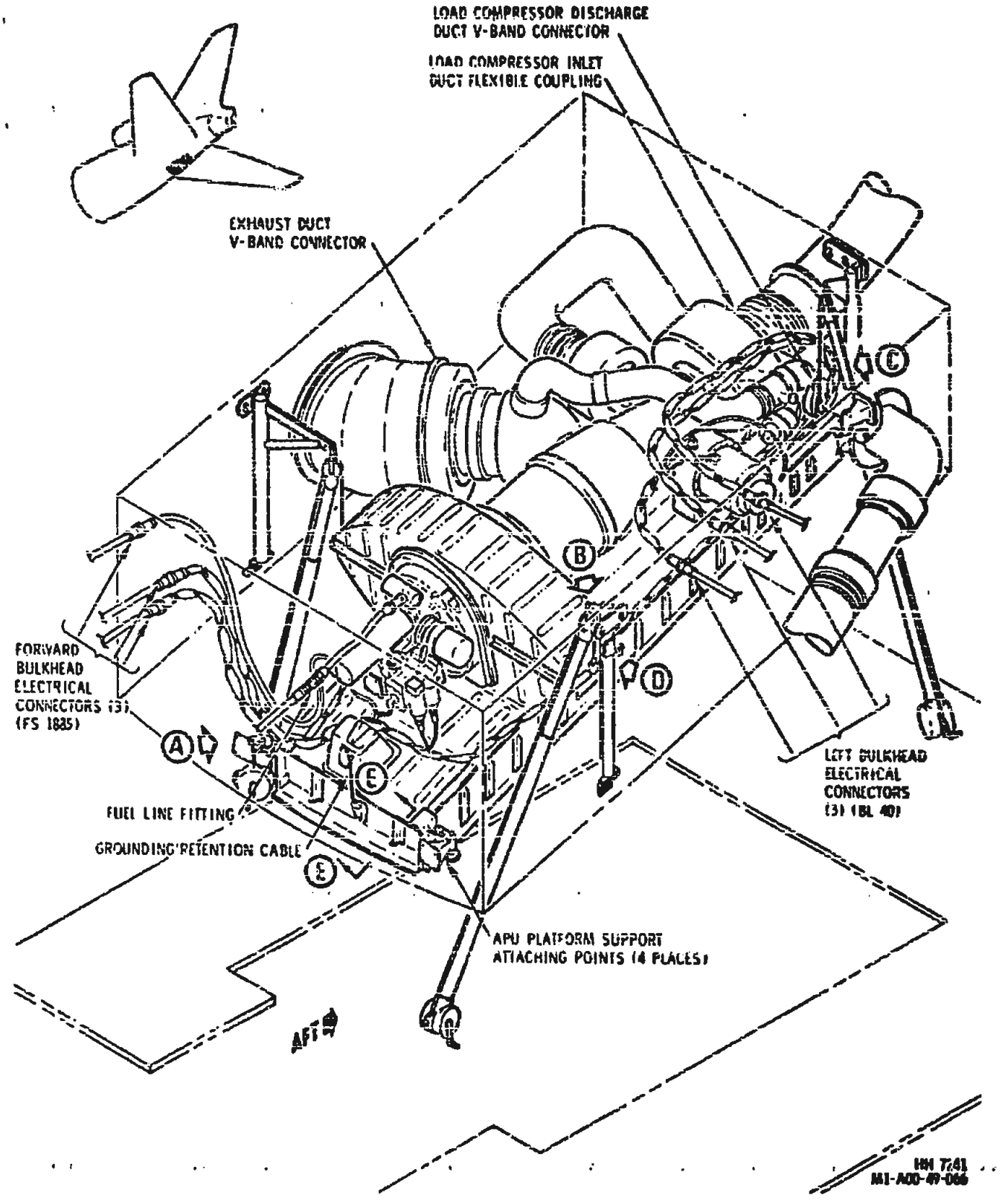
(a) Disconnect APU platform grounding strap and cable at bulkhead fitting.

(b) Disconnect electrical connectors P1, P2 (JP1), and P3 (JS1) from bulkhead connectors.

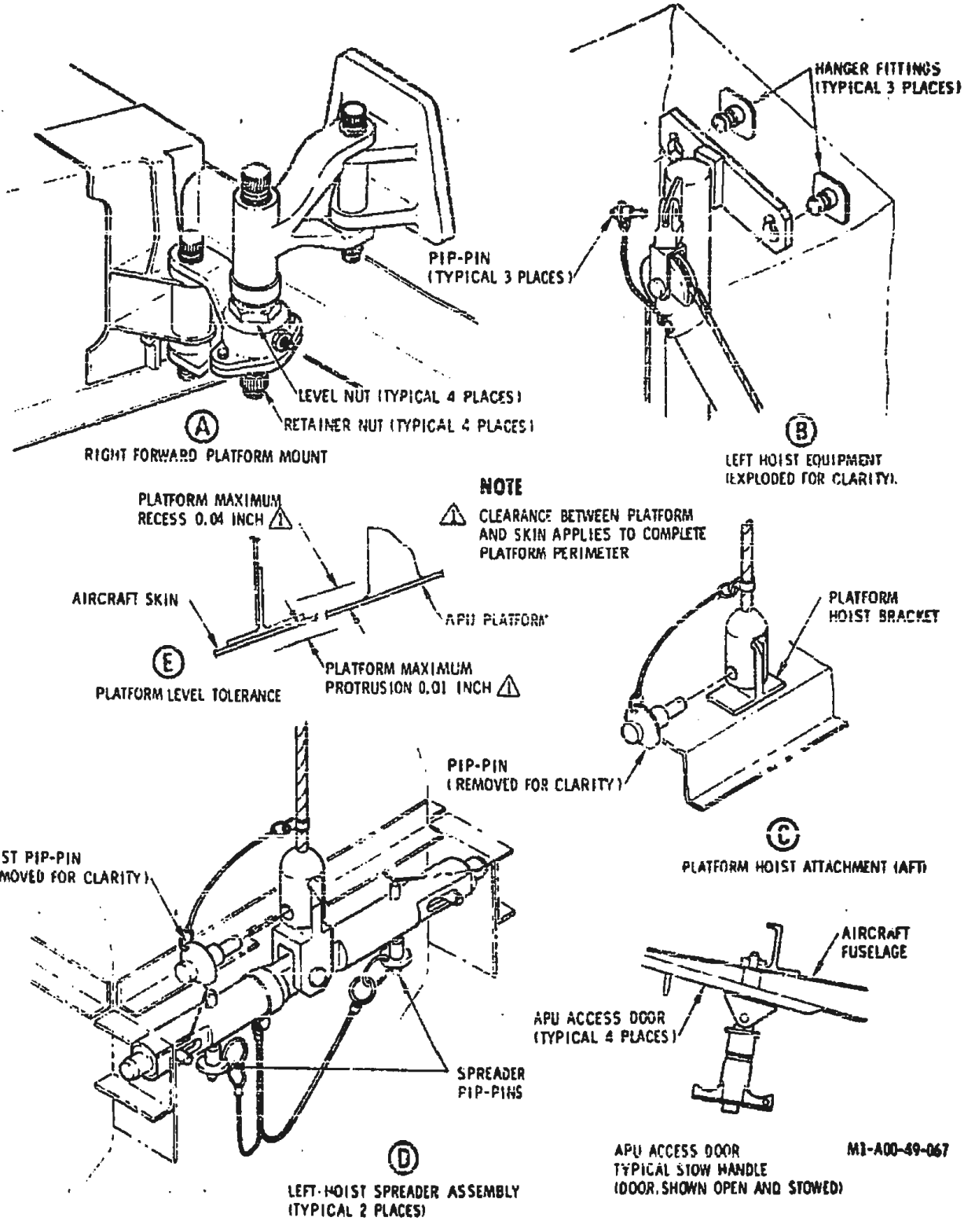
(c) Disconnect harness-to-bulkhead retaining clips.



APU Assembly - Removal and Installation
Figure 401 (Sheet 1)



APU Assembly - Removal and Installation
Figure 401 (Sheet 2)



APU Assembly - Removal and Installation
Figure 401 (Sheet 3)

(d) Remove fuel inlet line support clamp and disconnect APU fuel inlet hose at bulkhead fitting. Drain fuel hose into one-gallon bucket. Cap fuel line and bulkhead fitting.

(e) Stow disconnected fuel line and electrical harnesses on APU platform.

(7) On left side of APU compartment, at BL 40, perform the following:

(a) Disconnect APU generator electrical cables at T0, T1, T2, and T3 terminal studs. Pull electrical cables 2424-1A4A and 2424-1E4A clear of current transformer. Stow cables in convenient location clear of APU.

(b) Disconnect generator wiring harness connectors 2424-P1, 2424-P13, and 2424-P14 at receptacles on generator and generator adapter. Stow harnesses in convenient location clear of APU.

(c) Remove load compressor discharge duct V-band connector.

(d) Mount left hoist adapter (BA 22-101) on adapter hanger fittings.

(e) Extend portable hoist pole to fourth adjustment hole; lift hoist into position and attach it to left hoist adapter.

(f) Unwind portable hoist cable and attach end fitting to hoist spreader on left side of APU. Manually operate hoist until all cable slack is taken up.

(8) Perform the following at the right side of APU compartment:

(a) Remove exhaust duct V-band clamp.

(b) Disconnect air vent ejector electrical connector; stow wiring and connector at convenient location clear of APU.

(c) Disconnect fire detector sensor assembly at air vent ejector and secure sensor in convenient location clear of APU. If air vent ejector assembly is to be removed for installation on replacement APU, refer to 49-11-20.

(d) Mount right hoist adapter (BA 23-101) on adapter hanger fittings.

(e) Lift portable hoist, with pole fully retracted, into position and attach it to right hoist adapter.

(f) Unwind portable hoist cable and attach end fitting to hoist spreader at right side of APU. Manually operate hoist until all cable slack is taken up.

(9) In aft section of APU compartment, at bulkhead (FS 1975), perform the following:

(a) Loosen aft air inlet boot clamp and slide boot off of compressor air inlet duct elbow.

(b) Mount aft hoist adapter (BA 24-101) or adapter hanger fittings.

(c) Extend portable hoist pole to the fourth adjustment hole, lift hoist into position and attach it to aft hoist adapter.

(d) Unwind portable hoist cable and attach end fitting to APU platform hoist bracket. Manually operate hoist until all cable slack is taken up.

WARNING: APU ASSEMBLY WEIGHS IN EXCESS OF 800 POUNDS. APU MUST BE PROPERLY ATTACHED TO HOISTING EQUIPMENT.

CAUTION: SEPARATION OF THE APU QEC FROM THE PLATFORM SUPPORTS AND THE TRANSFER OF WEIGHT TO THE PORTABLE HOIST EQUIPMENT MUST BE DONE WITH EXTREME CARE. BEFORE COMPLETELY REMOVING APU SUPPORT FITTING NUTS ENSURE THAT HOIST CABLES, PIP PINS, HOIST SPREADERS, AND HOIST ADAPTERS ARE CORRECTLY POSITIONED AND SECURED.

(10) Slowly loosen each APU platform support nut until the nut begins to thread off the platform support fitting bolt. As the nuts are backed off verify that the APU platform lowers and applies increasing tension to the hoist cables.

(11) Connect shop air hoses to portable hoists and simultaneously operate the three hoists to slowly raise APU platform until its weight is no longer on the platform support nuts. Check that each of the hoist cables is under tension and supporting the APU. Verify that all three hoist adapters are still correctly positioned in their respective adapter hanger fittings.

CAUTION: BE SURE THE AFT RIGHT PLATFORM MOUNT LINK IS ROTATED TO A POSITION AGAINST THE COMPARTMENT AFT WALL. THIS MUST BE DONE TO PREVENT DAMAGING THE APU AIR INLET DUCT.

(12) Remove nuts and washers from platform support fittings.

CAUTION: WHEN LOWERING THE APU, KEEP IT AT APPROXIMATELY THE SAME ANGLE AS IT IS WHEN INSTALLED. AT LEAST ONE OBSERVER MUST BE STATIONED IN A POSITION THAT PERMITS HIM TO OBSERVE THE APU AND DIRECT THE HOIST OPERATORS AS THEY LOWER THE UNIT. BE SURE THE EXHAUST DUCT AND LOAD COMPRESSOR DUCTS HAVE ADEQUATE CLEARANCE.

CLEARANCE BETWEEN APU COMPARTMENT WALL AND STARTER ON APU'S HAVING A STARTER CLUTCH IS MARGINAL. OBSERVE STARTER VERY CLOSELY WHEN LOWERING APU.

(13) By coordinated operation of the three portable hoist mechanisms, slowly lower APU clear of the APU compartment.

(14) Lower APU onto the APU support dolly and secure platform support fittings to dolly.

(15) Loosen clamp and separate air inlet duct boot from inlet guide vane assembly. Retain for reinstallation on new APU.

(16) Detach hoist cables and remove hoist spreader assemblies. Install APU closure kit items HS P/N GS14786-1.

C NOTE: If unit is being forward to Hamilton Standard
C for repair, accomplish M11-49-03. Upon return
C of repaired unit, reinstall unit per M11-49-04.

(17) Inspect APU load compressor air inlet duct for general condition, cracked airflow guide vanes, and cracks in the wall at the vane-to-wall attach tabs. If necessary, remove and repair duct (Ref. 49-51-25).

(18) Inspect APU compartment insulation blanket for security of attachment to structure at all fasteners and for gouges and tears. If damage is not extensive, blanket may be repaired without removal (Ref. 49-11-25).

CAUTION: APU QEC's WITH SLOTTED EJECTOR DOORS MUST ONLY BE USED ON AIRCRAFT WITHOUT A SECONDARY VENT DUCT AND VALVE, OR ON AIRCRAFT THAT HAVE THE SECONDARY VENT DUCT AND VALVE DEACTIVATED.

APU QEC's WITH UNMODIFIED (NON-SLOTTED) EJECTOR DOORS MUST ONLY BE USED ON AIRCRAFT WITH FUNCTIONING SECONDARY VENT VALVES.

C. Installation

NOTE: Before installing APU QEC unit, verify that all components comprising the applicable APU QEC configuration are installed.

(1) Wheel APU support dolly containing APU QEC ready for installation into position beneath APU compartment, zone 319.

(2) Install load compressor air inlet duct boot on inlet guide vane assembly and secure with clamp.

(3) Position maintenance stand below aircraft APU compartment.

(4) If not already installed in APU compartment, mount left, right, and aft hoist adapters on adapter hanger fittings (Ref. Step 3B and Fig. 401).

R (5) Verify that circuit breakers opened in Step 3A(2) are opened and tagged.

(6) Attach hoist spreaders (BA 25-101) to APU plenum chamber hoisting brackets.

(7) If not already installed, extend portable hoist pole to the fourth adjustment hole and attach it to the left hoist adapter. Then unwind portable hoist cable and attach cable fitting to hoist spreader on left side of APU plenum.

(8) If not already installed, attach portable hoist (with pole fully retracted) to the right hoist adapter. Then unwind portable hoist cable and attach cable fitting to hoist spreader on right side of APU plenum.

(9) If not already installed, extend portable hoist pole to the fourth adjustment hole and attach it to aft hoist adapter. Then unwind portable hoist cable and attach cable fitting to hoist bracket at aft end of APU platform.

WARNING: APU ASSEMBLY WEIGHS IN EXCESS OF 800 POUNDS. APU MUST BE PROPERLY ATTACHED TO HOISTING EQUIPMENT.

(10) In APU compartment, remove platform support fitting bolts.

(11) Remove all duct covers, plugs, and protective materials from APU.

(12) Loosen support dolly APU holddown fittings.

(13) Hang V-band clamp on APU load compressor discharge duct flange.

NOTE: It is recommended to hang V-band clamp on load compressor discharge duct flange prior to installing APU in aircraft. After installation of APU, the clamp is opened slightly to slip over mating duct flange and torqued. This minimizes clamp flexing and difficulty of working clamp into place after APU is installed.

WARNING: BEFORE OPERATING PORTABLE HOISTS TO LIFT APU, VERIFY THAT ALL CABLES, PIP PINS, HOIST ADAPTERS, AND HOIST SPREADERS ARE PROPERLY INSTALLED. WHILE HOISTING, KEEP PLATFORM AT APPROXIMATELY THE ANGULAR POSITION IT WILL HAVE WHEN INSTALLED (AFT END UP).

CAUTION: AT LEAST ONE OBSERVER MUST BE POSITIONED IN APU ACCESS PANEL AREA TO OBSERVE AND GUIDE THE UNIT INTO THE APU COMPARTMENT. MAKE SURE EXHAUST AND LOAD COMPRESSOR DUCTS HAVE ADQUATE CLEARANCE.

VERIFY THAT LINK ON AFT RIGHT PLATFORM SUPPORT FITTING IS ROTATED AGAINST AFT COMPARTMENT WALL TO PROVIDE CLEARANCE FOR APU COOLING AIR DUCT.

(14) Attach shop air hoses to the portable hoists. Carefully take up cable slack until APU starts to lift off the support dolly. Check hoist attach points for secure attachment to hoist adapters, then raise the APU free of the dolly. Raise aft end of APU platform until assembly is at the same angle as installed in the aircraft. Continue raising platform into the APU compartment. EXERCISE EXTREME CARE TO PREVENT STARTER FROM STRIKING AIRCRAFT STRUCTURE.

CAUTION: ON APU'S EQUIPPED WITH A STARTER CLUTCH, CLEARANCE BETWEEN STARTER AND APU COMPARTMENT IS VERY CLOSE. EXERCISE EXTREME CARE TO PREVENT STARTER FROM STRIKING AIRCRAFT STRUCTURE.

As APU enters APU compartment and approaches its installed position, guide compressor air inlet duct boot onto the air inlet duct elbow.

(15) Align aft left platform support fittings. Move swing links on remaining three supports into alignment with platform support brackets.

(16) Lubricate and install the platform support fitting bolts with antiseize compound. Install the platform support washers and self-locking nuts. Tighten nuts, but do not apply full torque value at this time. Check APU platform-to aircraft skin clearance (Ref. Fig. 401, View E). Allowable mismatch is 0.01 inch and 0.04 inch (platform recessed). Adjust as follows:

(a) If platform must be lowered, slacken hoist cable and loosen platform support nut, and rotate hexhead adjustment bolt between platform fitting and swing link (or fitting) counterclockwise. (One complete turn of bolt provides a 0.050-inch vertical movement.) Then tighten support nut and recheck skin alignment.

(b) If platform must be raised, loosen support nut and rotate adjusting bolt clockwise. Tighten hoist cable to lift APU and take up clearance between adjusting nut and platform support fitting. Then tighten support nut and recheck skin clearance.

(c) Tighten platform support nuts to a torque value of 465 to 510 lb in.

(17) Slacken hoist cables and remove hoists and adapters.

CAUTION: VERIFY THERE IS APPROXIMATELY 1/2 INCH CLEARANCE BETWEEN SURGE VALVE J-TUBE AND GENERATOR HOIST BRACKET BOLTS IN COMPARTMENT CEILING.

ALSO CHECK FOR CLEARANCE BETWEEN OTHER APU COMPONENTS AND COMPARTMENT CEILING BLANKETS OR STRUCTURE.

IF ANY APU COMPONENT IS RUBBING AGAINST CEILING STRUCTURE OR BLANKETS. CHECK FOR PROPER ASSEMBLY OF AFFECTED COMPONENT.

VERIFY THAT BLANKET FASTENERS SUPPORT THE BLANKET CLEAR OF APU.

(18) Visually inspect for clearance between APU components and compartment ceiling. Ensure APU components are not rubbing against ceiling structure or blankets.

(19) Lubricate platform supports (Ref. 12-21-46).

(20) On left side of APU compartment:

(a) Remove spreader assembly.

CAUTION: MAKE SURE V-COUPLING IS PROPERLY POSITIONED ON DUCTING BEFORE TORQUING. TORQUE COUPLING NUT TO OBTAIN FREE SIDE PLAY OF BUILT-IN DYNA GAGE (REF. 20-36-01). DO NOT OVERTORQUE.

(b) Position load compressor discharge duct against compressor discharge flange. Position V-band connector on duct flange and tighten nut to the required load as indicated by the Dyna gage.

(c) Route APU generator electrical cables 2424-1A4A and 2424-1E4A through current transformer to generator terminal stud T1.

(d) Connect APU generator electrical cables to generator terminal studs as follows:

Connect 2424-1A4A and 2424-1E4A cables to terminal stud T1. Connect 2424-2A4B and 2424-2E4B cables to terminal stud T2. Connect 2424-3A4C and 2424-3E4C cables to terminal stud T3. Connect 2424-83A6N and 2424-83C6N cables to terminal stud T0. Torque 162 to 180 lb-in.

(e) Connect electrical harnesses 2424-P13 and 2424-P14 to respective receptacles on generator and 2414-P1 harness to receptacle on generator adapter.

(21) On the right side of the APU compartment:

(a) Remove spreader assembly.

(b) Pull exhaust duct transition into contact and alignment with exhaust muffler shroud and install V-band clamp. (Exhaust transition may be rotated to facilitate alignment with muffler shroud.) Torque clamp nut to 11 (±1) lb in. and add lock-wire.

CAUTION: APU QEC's WITH SLOTTED EJECTOR DOORS MUST ONLY BE USED ON AIRCRAFT WITHOUT A SECONDARY VENT DUCT AND VALVE, OR ON AIRCRAFT THAT HAVE THE SECONDARY VENT DUCT AND VALVE DEACTIVATED.

APU QEC's WITH UNMODIFIED (NON-SLOTTED) EJECTOR DOORS MUST ONLY BE USED ON AIRCRAFT WITH FUNCTIONING SECONDARY VENT VALVES.

(c) Install air vent ejector assembly if previously removed in Step 3B(8)(c) [Ref. 49-11-20]. Connect air vent ejector wiring harness to ejector actuator receptacle and add lock-wire.

CAUTION: BE CERTAIN THERE IS AT LEAST 1/4-INCH CLEARANCE BETWEEN FIRE DETECTOR SENSOR WIRING AND EXHAUST DUCT, AND BETWEEN FIRE DETECTOR WIRING AND UPPER AIR VENT EJECTOR DOOR WHEN IT IS OPEN.

(d) Attach fire detector sensor to support clips at top of air vent ejector assembly.

(22) Secure load compressor air inlet duct boot to air inlet duct elbow with clamp. Tighten clamp to a torque value of 20 lb in.

(23) At the APU compartment forward bulkhead:

(a) Attach APU platform grounding strap and cable to bulkhead fitting.

(b) Connect electrical connectors P1, P2, (JP1) and P3 (JS1) to their respective bulkhead connectors. Install harness retaining clips on bulkhead.

(c) Connect APU fuel inlet hose to bulkhead fuel line fitting, and install hose support clamp.

R (24) In zone 317, check position of manual override lever on R APU primary emergency fuel shutoff valve actuator. If R not in valve closed position, manually move lever to R closed position.

R (25) In zone 317, position manual override lever on APU R secondary emergency fuel shutoff valve actuator to the R open position.

R (26) Check APU oil supply and replenish as necessary (Ref. 12-12-41).

R (27) Check APU generator adapter for correct oil level. Replenish as necessary (Ref. 12-12-51).

R (28) Check APU starter clutch for correct oil level. Replenish as necessary (Ref. 12-12-41).

R (29) Remove tags and close circuit breakers opened in Step 3A(5).

R (30) If installed APU was a preserved item, perform depreservation (Ref. 49-21-01) and proceed to Step 3C(29). If APU was not a preserved item, perform the following:

(a) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag the APU BAT BUS - IGNITION (S11) circuit breaker.

(b) On FE/SO CONTROL panel, zone 215, turn on MASTER BATTERY POWER switch.

(c) On APU Control panel, zone 215, place APU Master Power switch to ON position.

(d) Perform an APU wet cycle by momentarily depressing the APU START switchlight on the APU CONTROL panel and motoring the engine through one false start cycle.

(e) Check the APU installation for signs of oil or fuel leaks.

(f) Remove drip tank drain plug and drain the drip tank. Reinstall drain plug and add lock-wire.

(g) Recheck the APU tank and generator adapter oil levels and add oil as required (Ref. 12-12-41 and 12-12-51).

(h) On the FE/SO aft circuit breaker panel CB3, zone 215, remove tag and close APU BAT BUS-IGNITION (S11) circuit breaker.

CAUTION: ENSURE ALL TOOLS AND EQUIPMENT ARE REMOVED FROM APU COMPARTMENT AREA.

R (31) In the AEEA, zone 164, adjust the Ng trim speed adjustment on the front of the electronic control unit (Ref. 49-00-02).

R (32) Close APU compartment access doors.

R (33) Rotate hinged section of the fluid scupper installation aft against the APU air inlet door fence.

R (34) Remove MAINTENANCE-IN-PROGRESS tags installed in Flight Station at Step 3A(2).

R (35) Operate APU and check APU operation (Ref. 49-00-01).

CR (36) Close APU access doors and catcher assembly on inlet
C scupper system.

C D. Removal Report Procedure

C (1) Failure or unscheduled removal of an APU - the
C Maintenance Supervisor or Passenger Service Manager (as
C applicable), shall submit a report on the incident by
C teletype to MCIMD, MCIMC, JFKWQ, and MCIEE containing
C the following information.

C (a) Plane Number

C (b) Station

C (c) Date or removal

C (d) Arrival Flight Number

C (e) APU Serial Number Removed

C (f) Logbook entries

C (g) Checks and/or tests made by Maintenance.

C (h) Maintenance findings.

C (i) Type of metal in screen. If screen is not
C checked, it should be so indicated.

C NOTE: Any metal found in screen is to be put in
C "Metal in Sump" envelope, Form ENG 437.
C The required information on the front and
C back sides of envelope filled in, and sent
C immediately to Supervisor - Power Plant
C Engineering, MCI Building No. 2.

C (j) APU Serial Number installed

C (2) Removal of an APU for time - the Maintenance Supervisor
C or Passenger Service Manager (as applicable), shall
C submit a report by teletype to MCIMC, JFKWQ, and MCIEE
C containing the following informaltion.

C (a) Plane Number

C (b) Station

C (c) Date of removal

C (d) Arrival Flight Number

C (e) APU Serial Number removed

C (f) APU Serial Number installed

AUXILIARY POWER UNIT (APU) - ADJUSTMENT AND TEST

1. Adjustment/Test

This section contains procedures for performing the following operations:

	Procedure	Paragraph
	Operational Test	3
	Preparation	3A
	APU Operation	3B
	APU Shutdown (Normal)	3C
	APU Shutdown (Using External Control Panel)	3D
	APU Automatic Shutdown	3E
R	DELETED	4
	Wet Cycle	5
	Dry Cycle	6
	Manual Fire Shutdown (APU Not Running)	7
	Autofire Shutdown (APU Running)	8
	APU Fault Flag Test	9

2. Referenced Procedures

12-12-41	Auxiliary Power Unit - Oil Replenishing
12-12-51	Auxiliary Power Unit - Generator Oil Replenishing
20-31-00	Proximity Sensor Artificial Target - Maintenance Practices
24-41-00	External Power/Ground Service System - Maintenance Practices

26-11-00	Fire Detection System - Adjustment and Test
26-21-00	Fire Extinguisher System - Adjustment and Test
26-21-04	Dual-Wired Initiator Cartridge - Removal and Installation
32-63-00	Air/Ground Sensing - Maintenance Practices
49-00-01	Auxiliary Power Unit (APU) - Maintenance Practices
49-00-02	Electronic Control Unit - Removal and Installation
49-11-00	Power Plant System - Fault Isolation
49-21-01	APU Gas Turbine - Servicing
49-75-03	N2 Overspeed Fault Indicator Flag - Maintenance Practices
49-91-05	High Temp Fault Indicator Flag - Maintenance Practices
49-91-06	Low Pressure Fault Indicator Flag - Maintenance Practices

3. Operational Test

A. Preparation

(1) Verify APU exhaust outlet, load compressor air inlet duct, and vent ejector air exit are clear of obstructions and ground support equipment.

(2) Check APU oil tank and generator adapter oil levels and replenish as necessary (Ref. 12-12-41 or 49-21-01, and 12-12-51).

CAUTION: DO NOT OPERATE APU WHILE ANTI-ICING FLUID IS BEING APPLIED TO AFTERBODY AND EMPENNAGE AREAS.

C DO NOT OPERATE APU WITH AN INOPERATIVE APU
C GENERATOR OR ADAPTER. THE ONLY EXCEPTION IS FOR
C TROUBLESHOOTING THE GENERATOR OR ADAPTER AND THEN
C OPERATING TIME SHOULD BE MINIMUM.

(3) On the pilots overhead circuit breaker panel CB1, zone 210, verify the following circuit breakers are closed:

FIRE DETECTION

LOOP A ALARM - APU (K7)

LOOP B ALARM - APU (K8)

MASTER ALARM PWR - WHL WELL - APU (J4)

TEST (J5)

FIRE BELL PWR (J6)

APU FIRE SHUTDOWN (J7)

APU SEC EMER SHUTOFF (J8)

On aircraft 032-999,
APU BLEED AIR VALVE (H13)

ENGINE BLEED CONTROL

FUS ISLN VALVE (G16)

CROSS BLEED VALVES - L and R (G17, G18)

LANDING GEAR

PROX SW PWR - NO. 1 and No. 4 (L10, L11)

FUEL SHUTOFF VALVE PRI EMER - APU (D15)

APU FIRE DETECT

ALARM LOOP - A and B (D16, D17)

MASTER ALARM PWR (D18)

FIRE EXTINGUISHER

APU - MAIN (C16)

APU - ALTN (C17)

APU FIRE SHUTDOWN (C18)

(4) On the Flight Engineer/Second Officers overhead circuit breaker panel CB2, zone 215, verify the following circuit breakers are closed:

GROUND SERVICE

MLG GND SENSE (L8)

IND LT - F/E PANEL - LOWER (J4), UPPER (J3)

INDICATOR

F/E IND LT TEST 4 (H4)

FIRE EXT LT (F7)

(5) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, verify that the following circuit breakers are closed:

FUEL SYSTEM

OUTBD BOOST PUMP 2L and 2R (U3, U4) or (U5, U6)

INBD BOOST PUMP - TANK 2L and 2R (U8, U9)

ENG 2 TANK VALVE (T9)

FIRE HORN (S6)

FIREWALL SHUTOFF - PRIM and SEC (S7, S8)

R APU BAT BUS

IGNITION (S11)

CONT PWR (S12)

POWER CONTROL (S13)

On aircraft 001-031,
EJECTOR & VENT VALVE (S15)

On aircraft 032-999,
EJECTOR (S15)

APU POWER

BAT PWR (B10)

APU T/R PWR (B11)

CONTROLLER - BUS 2 and GND BUS (B13, B14)

CONTROL & PRI F/W SOV - GND BUS and BUS 2 (B15, B16)

APU GEN CONT UNIT (B17)

On aircraft, 001-031,
APU BLEED AIR VALVE (S18)

B. APU OPERATION

CAUTION: OPERATOR MUST REMAIN IN ATTENDANCE IN FLIGHT STATION AT ALL TIMES APU IS OPERATING WITH APU AUTOFIRE SHUTDOWN SYSTEM INOPERATIVE.

CR NOTE: During APU operation, the following Cavity Drain
CR Leakage Limits apply:

DRAIN LINE LOC.	MAXIMUM PERMISSIBLE LEAKAGE DURING ENGINE OPERATION
FUEL PUMP	45 CC/HR 15 DROPS/MIN (SEEPAGE)
DUMP VALVE	0.2 CC/MIN 4 DROPS/MIN
STARTER CAVITY	3 CC/HR 1 DROP/MIN
GAS GENERATOR CASE (2 DRAINS)	NO MEASURABLE LEAKAGE ALLOWED
COOLING FAN	NO MEASURABLE LEAKAGE ALLOWED
GENERATOR DRIVE CAVITY	NO MEASURABLE LEAKAGE ALLOWED

(1) On FE/SO ELECTRICAL panel:

(a) Place DC VOLTS/AMPS meter select switch to BAT position.

(b) Place AC VOLTS/FREQ meter select switch to APU position.

(2) On FE/SO HYDRAULIC SYSTEM panel (if hydraulic systems are inactive):

(a) Verify that B2 and C2 ATM select switches are in OFF position.

(b) Verify that B3 and C3 AC PUMPS switchlights are in the OFF positions.

(3) If external power is applied to the aircraft, place the EXT PWR switch to the ON position and perform APU fire detection and extinguisher tests (Ref. 26-11-00 and 26-21-00). If only aircraft battery power is available, place BATTERY switch on FE/SO electrical panel to ON position and perform fire detection loop test, then turn off BATTERY switch. Perform APU fire extinguisher test after APU has been started and is supplying electrical power to the dc busses.

(4) On FE/SO APU CONTROL panel:

(a) Verify BATTERY CONDITION light is off.

(b) Verify BLEED AIR S/O switchlight is in OFF position (released).

(c) Place APU compressor mode select switch in MIN MODE position.

(5) On FE/SO APU CONTROL panel, place the APU Master Power switch to the ON position.

(a) AUTOFIRE SHUTOFF ARMED LIGHT comes on.

(b) APU EMERGENCY SHUTOFF SEC light is off. (If valve is closed, the light will blink on, then off when the START switch is depressed in Step 8)

(c) APU EMERGENCY SHUTOFF PRI light may blink on, then off.

(d) Verify that all fault flags are cleared. Depress RESET switch to clear a visible fault flag and do not operate APU until cause of flag indication is determined and corrected.

(6) On FE/SO ELECTRICAL panel, momentarily depress APU GENERATOR FIELD TRIP switchlight.

CAUTION: DO NOT OPERATE THE APU UNLESS THE ENG NO. 2 FUEL FEED AND APU FUEL SUPPLY SYSTEMS ARE INTACT AND OPERATIONAL.

NOTE: Fuel is supplied to the APU through two electrically operated emergency fuel shutoff valves and a hose connected to a fitting in the No. 2 engine fuel feed line. The ENG 2 TANK VALVE must therefore be open to provide fuel for APU operation.

(7) On FE/SO FUEL SYSTEM panel:

(a) Verify that ENG 2 TANK VALVE is open (switchlight flowbar light is on; disagreement light is off).

NOTE: The ENG 2 TANK VALVE is normally in the open position. If left closed (switchlight depressed and latched) when power was last removed from the aircraft, it can be electrically opened only when DC BUS 2 is again energized. If power is not available to energize DC BUS 2, the valve may be opened by moving the manual override lever

on the valve actuator to the OPEN position. If this is done, the switchlight must be released (flush with panel) to establish agreement between switchlight and valve positions.

CAUTION: ON AIRCRAFT 001-031,
DO NOT OPERATE BOOST PUMP WITH LESS THAN 1200 POUNDS/545 KILOGRAMS OF FUEL IN TANK UNLESS THE BOOST PUMP HAS BEEN INSPECTED (REF. 28-24-02, PARA. 48(4) AND SB28-031).

IF BOOST PUMP CIRCUIT BREAKER TRIPS, DO NOT RESET UNTIL IT IS VERIFIED, BY INSPECTION, THAT CIRCUIT BREAKER TRIP IS NOT CAUSED BY MALFUNCTION IN BOOST PUMP ASSEMBLY.

ON AIRCRAFT 032-999,
IF BOOST PUMP CIRCUIT BREAKER TRIPS, DO NOT RESET UNTIL IT IS VERIFIED, BY INSPECTION, THAT CIRCUIT BREAKER TRIP IS NOT CAUSED BY MALFUNCTION IN BOOST PUMP ASSEMBLY.

(b) If the aircraft AC busses are energized, turn on one fuel boost pump in tank 2L and one in tank 2R.

NOTE: The APU can be started and operation sustained using only the suction pressure developed by the integral APU engine fuel pump. Boost pump operation, however, is advisable to relieve the load on the APU pump and assure a full head of fuel in the engine No. 2 fuel feed line.

(8) On APU CONTROL panel, hold APU START switch depressed for approximately 2 seconds and verify the following:

C (a) DELETED

C (b) When the DOOR IN TRANSIT light goes off, the
C starter begins to crank the APU (indicated by
C starter current indication on DC AMPS meter and
C rise in Ng indicator pointer). On aircraft with
C SB 49-034, the starter will begin to crank the APU
C simultaneously with the door in transit light
C indication.

C (c) DONT LOAD light (on APU CONTROL panel) and GEN OIL
C PRESS light (on ELECTRICAL panel) come on.

C (d) DC AMPS meter current drops to normal (negative
C current) indication (approximately 30 to 40

C seconds after DONT LOAD light comes on) to
C indicate termination of starter and ignition
C exciter operation.

C (e) TGT indication will appear at approximately 12 to
C 15 percent Ng followed by steady acceleration of
C Ng and TGT indicator pointers to stabilized
C positions in the green operating band of the
C indicators.

C (f) GEN OIL PRESS light goes off at approximately 60
C percent Ng.

C (g) DONT LOAD light goes off when free turbine speed
C stabilizes. (Ng and TGT pointers in green
C operating band on indicators). (Rev 35)

NOTE: During the start, an automatic APU shutdown will occur if:

- 55 percent Ng is not attained within approximately 30 to 40 seconds after the DONT LOAD light comes on.
- A free turbine speed (NfA) input signal is not applied to the ECU at 55 percent Ng. (Free turbine speed is indirectly shown by the rise in PMG voltage.)
- Engine speed accelerates abnormally to 110 percent Ng (OVERSPEED N2 fault flag trips).
- TGT rises higher than the maximum limiting value scheduled by the ECU (OVERTEMP TGT fault flag trips).
- APU oil pressure remains lower than 50 psig for 10 seconds after 55 percent Ng is reached. (This function is inhibited at engine speeds lower than 55 percent Ng.)
- An APU fault protection circuit is activated (Ref. 49-61-00, Fail-Safe Provisions).

CAUTION: DEPRESS APU STOP SWITCH AND TERMINATE START IF TGT IS OBSERVED TO INCREASE ABNORMALLY FAST OR IF Ng HANGS UP FOR MORE THAN 5 SECONDS BEFORE STABILIZING IN THE GREEN OPERATING BAND.

TWO CONSECUTIVE STARTS MAY BE ATTEMPTED PROVIDED A 60-SECOND STARTER COOLING PERIOD IS ALLOWED BEFORE THE SECOND START. IF PROPER OPERATION IS NOT ACHIEVED ON SECOND START CYCLE, ABANDON ATTEMPTS TO OPERATE APU AND INVESTIGATE THE REASON FOR FAILURE TO START.

(9) Depress APU GENERATOR FIELD CLOSE switchlight. Verify switchlight flowbar light comes on. Check the generator frequency and voltage meters for stable APU generator operation.

(10) If on, place EXT POWER switch to OFF position. Verify APU GENERATOR BREAKER flowbar light comes on and APU generator load is indicated on load meter.

NOTE: At approximately 95 percent Ng the APU generator is connected to the AC TIE BUS and the APU continuous power circuits are transferred to T/R power. Failure of the APU to transfer to T/R power will result in a continuous drain of battery power. The situation can be detected by observing the DC AMPS meter (select switch in BAT position). With the APU running, the STBY POWER light on the ELECTRICAL panel out, and the battery charger in pulse mode, failure of the APU circuits to transfer to T/R power will be indicated on the DC AMPS meter by positive 5 to 10 amp pulses between each charging pulse.

(11) If not previously accomplished in Step 3B(3), perform APU fire extinguisher tests (Ref. 26-21-00).

(12) On FE/SO Engine Bleed Control panel, open aft fuselage isolation valve and turn on one ECS pack (Ref. 21-00-00).

CAUTION: DO NOT OPEN APU BLEED AIR SHUTOFF VALVE WITH ENGINE BLEED AIR APPLIED TO THE AIRCRAFT PNEUMATIC SYSTEM. ENGINE BLEED AIR REACTING AGAINST APU LOAD COMPRESSOR OUTPUT CAN DAMAGE THE LOAD COMPRESSOR DISCHARGE DUCT CHECK VALVE. DURING ENGINE STARTS USING APU AIR, SELECT MIN MODE AND CLOSE THE APU BLEED AIR SHUTOFF VALVE BEFORE USING ENGINE BLEED AIR TO START THE REMAINING TWO ENGINES.

(13) On APU CONTROL panel, depress and latch BLEED AIR S/O switchlight. The OPEN light in the BLEED AIR S/O switchlight must come on.

NOTE: A slight drop in TGT will occur as the ECS pack comes up to speed and is a good flight station indication that the APU compressor surge control system is responding to the air load demand created by the ECS pack.

(14) On ENGINE BLEED CONTROL PANEL, observe duct pressure on center indicator. Duct pressure should be between 10 and 12 psig under standard sea level conditions.

(15) On APU CONTROL panel, place compressor mode select switch to NORM position. Observe duct pressure increase to between 16 and 19 psig.

(16) Set compressor mode select switch to MIN MODE position. Observe drop in duct pressure. Set switch back to NORM position and observe increase in duct pressure.

C CAUTION: DO NOT OPERATE IN MAX MODE UNLESS ENGINES ARE
C BEING STARTED, THRUST REVERSERS ARE BEING
C OPERATED, OR FOR APU TROUBLESHOOTING.

(17) Manually hold compressor mode select switch in MAX MODE position. Observe duct pressure increase to between 24 and 29 psig.

NOTE: On aircraft 001-031, without SB49-035 (Rev. 1), the compressor mode select switch will remain in the MAX MODE position until manually returned to the NORM position.

NOTE: The MAX MODE light, when on, indicates that the APU load compressor inlet guide vanes are close to or at the full open (MAX MODE) position. Depending on operating conditions, this light can be on when in NORMAL mode. Under standard atmospheric conditions, the MAX MODE light should be on when operating with two ECS packs on and a maximum generator load of 20 KW. Since MAX MODE light operation at full open IGV postion is determined by a comparator circuit in the ECU, an LAC 672754-125 (or higher dash number) ECU must be installed in the aircraft.

(18) Set compressor mode select switch to NORM or MIN MODE position depending on air load requirements. If APU air is not required, set compressor mode select switch to MIN MODE and close BLEED AIR S/O valve.

(a) Surging of APU load compressor output can be caused by transient mismatching of load and compressor output when the load is suddenly reduced. The condition occurs when the surge control valve must suddenly dump excess air and seek a new level matching the reduced load requirements, and is most likely to occur during aircraft engine starts.

Surging will not occur when the load requirement exceeds compressor output. This fact provides a means of minimizing compressor surging.

(b) During engine start, select MIN MODE before starting the first engine. Keep electrical loads at a minimum. If surging occurs while starter is cranking, turn on one ECS pack. When practicable, turn off the ECS pack, close the APU bleed air shutoff valve, and use engine cross bleed to start the remaining engines.

C CAUTION: WITH ENGINE/S OPERATING, ENGINE ISOLATION
C VALVES MUST NOT BE OPEN UNTIL APU VALVE IS
C CLOSED. REVERSE FLOW OF AIR FROM THE ENGINE
C AT IDLE MAY FAIL THE APU CHECK VALVE.

(c) Always select MIN MODE before reducing ECS pack loads or closing APU bleed air shutoff valve.

(d) An INLET FLOW light legend on the APU CONTROL panel is illuminated and a load compressor air inlet duct differential pressure switch will shut down the APU if a blockage of airflow to the load compressor air inlet occurs. A shutdown due to this cause is indicated by illumination of the INLET FLOW light legend on the APU CONTROL panel and will most likely occur during operation under icing conditions. In such cases, an APU restart may be attempted by cycling the APU MASTER POWER switch off, then on (to reset the start circuitry and put out the INLET FLOW light) and waiting approximately 3 to 5 minutes for residual heat to melt any ice buildup in the air duct. If an INLET FLOW light indicated shutdown persists, the load compressor air inlet duct should then be inspected for blockage due to other causes. To prevent loss of APU air when using the APU for an engine start, the blocked air inlet flow shutdown circuit is inhibited when operating in MAX MODE.

C. APU Shutdown (Normal)

(1) Set compressor mode select switch to MIN MODE position.

(2) Reduce APU air load demands by turning off all ECS packs, ATM's, and AC hydraulic pumps (if operating).

(3) Close BLEED AIR S/O valve. Verify that BLEED AIR S/O switchlight OPEN light goes off and duct pressure drops slowly to zero psig.

(4) If external electrical power is applied to the aircraft, set EXT POWER switch to OFF position. Electrical system will transfer to APU power source and be indicated on APU load meter.

CAUTION: DO NOT SHUTDOWN APU USING APU MASTER SWITCH.

(5) On APU CONTROL panel, depress STOP switch and observe the following:

(a) APU generator drops off the line (Ref. 24-00-00).

(b) Ng and TGT readings drop off.

C (c) DELETED

C (d) DONT LOAD light comes on when STOP switch is
C depressed and remains on until MASTER POWER switch
C is placed to OFF position. (Rev 35)

NOTE: To provide adequate time for APU hot section cooling and temperature stabilization prior to complete shutdown, Ng speed will drop to 63 percent and the APU will operate at 63 percent Ng for approximately 85 seconds before shutting down. An emergency shutdown may still be initiated by pulling the APU FIRE PULL handle. If it becomes necessary to abort the stop, depressing the APU START button anytime before the 85-second idle period lapses will cause the APU to accelerate back to normal operating speed.

(6) Turn off tank 2L and 2R boost pumps (if on).

(7) Place APU MASTER POWER switch to the OFF position and observe the following results:

(a) GEN OIL PRESS and GENERATOR FIELD CLOSE switchlight flowbar lights go off.

(b) If external electrical power is on, APU EMERGENCY SHUTOFF PRI light on the FUEL SYSTEM panel will blink on, then off.

(c) All lights on the APU CONTROL panel that are on, go off.

D. APU Shutdown (Using External APU Control Panel)

(1) Depress NORM STOP switch. (APU will shut down.)

(2) Hold POWER ON switchlight depressed. Release switchlight when POWER ON light goes off.

E. APU Automatic Shutdown (Ref. 49-75-03, 49-91-05 and 49-91-06 for verification of operable APU auto shutdown function)

An automatic shutdown caused by a high TGT, low oil pressure, high oil temperature, or N2 overspeed may be accompanied by the tripping of more than one fault flag; the first flag to appear is the reason for the shutdown. (Refer to Section 49-11-00, Table 105 for an analysis of fault flag indications.)

If an APU shutdown is accompanied by an INLET FLOW light, the APU MASTER power switch must be cycled off, then on, before a restart can be initiated.

R 4. DELETED

C A. DELETED (Rev 35)

5. Wet cycle

A. Procedure

(1) On FE/SO aft circuit breaker panel CB3, zone 215, open and tag APU BAT BUS - IGNITION (S11) circuit breaker.

(2) Apply external electrical power (Ref. 24-41-00).

(3) On FE/SO APU CONTROL panel, place the APU MASTER POWER switch to the ON position.

(4) On FE/SO FUEL SYSTEM panel, open ENG 2 TANK VALVE (if closed).

(5) Turn on one boost pump in tank 2L and 2R.

(6) On APU CONTROL panel, depress START switch.

NOTE: APU starter will motor the APU for 50 seconds. If shorter duration is desired, depress STOP switch.

(7) While starter is motoring the APU, visually check for fuel and oil leaks. Check fuel pressurization and dump valves for proper operation. Listen for any sounds that would indicate rotor interference or abnormal operation.

(8) Set MASTER POWER switch to OFF position.

(9) Turn off tank 2L and 2R boost pumps.

(10) Remove tag and close circuit breaker opened in Step 3G(1).

(11) Remove external electrical power (Ref. 24-41-00).

(12) Drain APU drip tank.

6. Dry cycle

NOTE: Allow a minimum of 30 seconds between wet and dry cycles. Observe starter operating limitations [Ref. Step 3B(8)].

A. Procedure

(1) On FE/SO aft circuit breaker panel CB3 zone 215, open and tag circuit breakers FIREWALL SHUTOFF - PRIM (S7) and APU BAT BUS - IGNITION (S11).

NOTE: If last APU shutdown occurred with the APU as the only source of electrical power, the primary emergency fuel shutoff valve may be open. Visually determine valve position (override lever on valve actuator) and, if open, manually close the valve).

An alternate procedure to inhibit fuel flow to the APU would be to manually close the APU secondary emergency fuel shutoff valve (zone 319) and then open and tag circuit breaker FIREWALL SHUTOFF VALVE - SEC (CB3-S8).

(2) Apply external electrical power (Ref. 24-41-00).

(3) Apply APU MASTER POWER.

(4) Depress APU START switch. (APU will motor for 50 seconds. If a shorter duration is desired, depress STOP switch.)

(5) Set MASTER POWER switch to OFF position.

(6) Remove tags and close circuit breakers (S7) and (S11) opened inStep 6A (1).

(7) Manually open APU secondary emergency fuel shutoff valve (if previously closed).

(8) Remove external electrical power (Ref. 24-41-00).

7. Manual Fire Shutdown (APU Not Running)

A. Operational Test

(1) Verify the following conditions:

(a) On the APU CONTROL panel, the APU MASTER POWER switch is in the OFF position.

(b) FE/SO FIRE PULL handle is fully stowed.

(c) All fuel boost pumps are off.

(d) AUTOFIRE SHUTDOWN switchlight is in the flush (latched) ARMED position.

(e) APU FIRE PULL handle on the APU external control panel is stowed.

(f) Main landing gear air/ground sensors are in ground position (Ref. 32-63-00).

(2) Apply external electrical power (Ref. 24-41-00).

NOTE: In event the test is being done using only aircraft battery power, place the BATTERY switch on the FE/SO ELECTRICAL panel to the ON position before performing the test. Place BATTERY switch back to the OFF position when test is completed.

(3) On the pilots overhead circuit breaker panel CB1, zone 210, open and tag the FIRE EXTINGUISHER - APU - MAIN and ALT (C16 and C17) circuit breakers.

(4) On the FE/SO aft circuit breaker panel CB3, zone 215, open and tag APU BAT BUS - IGNITION (S11) circuit breaker.

(5) At the FE/SO FIRE DETECTION LOOP TEST panel, zone 215, perform an APU fire detection loop test (Ref. 26-11-00).

(6) On FE/SO APU CONTROL panel, place the APU MASTER POWER switch to the ON position.

(a) APU EMERGENCY SHUTOFF PRI light comes on, then goes off.

(b) AUTOFIRE SHUTDOWN ARMED light comes on.

CAUTION: THE FOLLOWING STEP SIMULATES AN AIRBORNE AIRCRAFT AND WILL AFFECT THE ON-THE-GROUND MODE CONDITION OF OTHER SYSTEMS. PERFORM STEPS (7) AND (10) IN ACCORDANCE WITH SECTION 32-63-00.

(7) Simulate an in-air condition at left and right MLG air/ground sensors using aluminum artificial targets (Ref. 20-31-00).

(8) Lift AUTOFIRE SHUTDOWN switchlight guard and depress (unlatch) AUTOFIRE switchlight. The ARMED light must go off.

(9) Remove aluminum targets from left and right MLG air/ground sensors (Ref. 20-31-01). The ARMED light must come on.

NOTE: In the following steps, be prepared to pull APU FIRE PULL handle after START switch is depressed and a rise in Ng indicator pointer is noted.

(10) Depress APU START switch and verify following results:

(a) DOOR IN TRANSIT light comes on, then goes off (approximately 10 seconds).

(b) DONT LOAD light comes on.

R (c) If secondary firewall shutoff valve was closed, the APU EMERGENCY SHUTDOWN SEC light comes on, then goes off.

(11) As the Ng indicator pointer starts to rise, abort the start by pulling APU FIRE PULL handle. Do not actuate the exposed fire extinguisher switches. Verify the following results:

(a) DOOR IN TRANSIT light comes on, then goes off.

(b) APU primary and secondary emergency fuel shutoff valves close (APU EMERGENCY SHUTDOWN PRI and SEC lights come on, then go off).

NOTE: A complete check of the manual fire shutdown system should, at this time, include a visual verification that the APU emergency primary and secondary fuel shutoff valves, air vent ejector doors are fully closed .

(12) Return APU FIRE PULL handle to its fully stowed position and turn off APU MASTER POWER.

(13) Establish interphone communication between FE/SO station and external APU control panel. Be prepared to pull the external panel APU FIRE PULL handle when informed that an APU start has been initiated and the DOOR IN TRANSIT light has gone off.

(14) Turn on APU MASTER power and repeat Steps 7A(10) through 7A(12) using the external APU FIRE PULL handle to abort the start.

(15) On the APU CONTROL panel, turn off the APU MASTER POWER switch.

(16) Disconnect interphone equipment and close external control panel access door.

(17) Close circuit breakers (C16, C17, and S11) opened in Steps 7A(3) and 7A(4).

(18) Remove external electrical power (Ref. 24 41 00).

(19) Lift the AUTOFIRE SHUTDOWN switchlight guard and depress (latch) the AUTOFIRE switchlight.

8. Autofire Shutdown (APU Running)

CAUTION: DO NOT CRANK AND/OR START APU MORE THAN THREE TIMES WITHIN A 30 MINUTE PERIOD. IF THREE CRANKS AND/OR STARTS HAVE BEEN MADE WITHIN A 30 MINUTE PERIOD, WAIT AT LEAST 30 MINUTES BEFORE CRANKING AND/OR STARTING APU AGAIN.

A. Operational Test

NOTE: The APU can be shutdown by pulling the FIRE HANDLE at either control panel. If a fire occurs, with the AUTOFIRE SHUTDOWN in the ARMED position (ARMED light on), the APU automatic fire shutdown system will automatically shut down the APU; the fire extinguisher bottle will also discharge if the main initiator cartridge (squib) is not deactivated. The alternate fire extinguisher bottle can be discharged at either control panel.

(1) On the Pilots overhead circuit breaker panel CB1, zone 210, verify the FIRE EXTINGUISHER - APU MAIN and ALTN (C16 and C17) circuit breakers are closed.

(2) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, verify the FIRE HORN (S6) circuit breaker is closed.

(3) Disconnect APU main initiator cartridge (squib) electrical connector. (APU alternate initiator cartridge (squib) remains connected and is not actuated by AUTO FIRE shutdown circuit) (Ref. 26-21-04).

(4) Operate APU in MIN MODE with bleed air shutoff valve open.

(5) Verify the AUTOFIRE SHUTDOWN switchlight is (latched) in. The ARMED light must be on.

(6) On the FE/SO FIRE DETECTION LOOP TEST panel select APU loop switch to BOTH position.

NOTE: To prevent unnecessary sounding of APU fire horn, be prepared to open FIRE HORN (CB3-S6) circuit breaker.

R (7) On aircraft 001-031 without SB26-020,
R in the FESC, set the APU Fire Detection Control Unit
R (FDCU) FAULT ISO OPER switch to the B position.

R (7) On aircraft 001-031 with SB26-020 and 032-999,
R in the FESC, configure aircraft for test as follows:

R (a) Disconnect APU Fire Detection Control Unit (FDCU)
R Plug 2611-P12.

R (b) Remove wires 2611-40021D18 (Pin 15) and
R 2611-40021P20 (Pin 18) from Plug 2611-P12.

R (c) Jumper wires 2611-40021D18 and 2611-40021P20
R together.

R (d) Reinstall Plug 2611-P12.

R (e) Set the FDCU FAULT ISO OPER switch to the B
R position.

(8) On the FE/SO FIRE DETECTION LOOP TEST panel select APU loop switch to A position. This produces a loop A fire signal. Verify the following results:

(a) APU fire warning horn sounds. Open FIRE HORN (CB3-S6) circuit breaker to silence horn.

(b) Fire alarm bell sounds. Depress BELL CUTOUT switch on FIRE DETECTION LOOP TEST panel to silence the bell.

(c) APU bleed air shutoff valve (also called APU duct isolation valve) closes, (BLEED AIR S/O OPEN light on APU CONTROL panel goes off).

(d) Vent ejector doors close, DOOR IN TRANSIT light comes on, then goes off.

(e) DONT LOAD light comes on.

(f) APU primary and secondary emergency fuel shutoff valves close (APU EMERGENCY SHUTDOWN PRI and SEC lights come on, then go off).

(g) Verify at APU main initiator cartridge (squib) electrical connector there is 18 to 34 VDC between pins 3 and 4, and 6 and 7.

(h) Visually confirm vent ejector door is closed and APU engine coasts to a full stop.

(9) On FE/SO FIRE DETECTION LOOP TEST panel return APU loop switch to BOTH position.

(10) Restart APU as in Step 8A(4).

R (11) In the FESC, set the APU FDCU FAULT ISO OPER switch to the A position.

(12) On FE/SO FIRE DETECTION LOOP TEST panel select APU loop switch to B position. This produces a loop B fire signal. Verify the results are the same as in Step 8A(8).

R (13) On aircraft 001-031 without SB26-020,
R in the FESC, set the APU FDCU FAULT ISO OPER switch to
R the OPER (center) position.

R (13) On aircraft 001-031 with SB26-020 and 032-999,
R restore aircraft to operations as follows:

R (a) In the FESC, disconnect APU FDCU Plug 2611-P12.

R (b) Remove jumper from wires 2611-40021D18 and
R 2611-40021P20.

R (c) Install wires 2611-40021D18 (Pin 15) and
R 2611-40021P20 (Pin 18) in Plug 2611-P12.

R (d) Reinstall Plug 2611-P12.

R (e) Set the FDCU FAULT ISO OPER switch to the OPER
R (center) position.

(14) Reconnect APU main initiator cartridge (squib) electrical connector (Ref. 26-21-04).

9. APU Fault Flag Test

A. Procedure

(1) Remove APU electronic control unit (ECU) (Ref. 49-00-02).

(2) Apply external electrical power (Ref. 24-41-00).

(3) On FE/SO APU CONTROL panel, place the APU MASTER POWER switch to the ON position.

(4) Depress fault flag RESET switch to clear any visible fault flags.

(5) Momentarily depress APU START switch.

(6) In AEEA, zone 164, momentarily ground each of the following pins of ECU receptacle P1A. Verify the corresponding fault flag on APU CONTROL panel trips when ground is applied. Fault flag must remain visible after being tripped.

P1A Pin	Fault Flag
10	LOW PRESS OIL
16	OVERTEMP TGT
38	OVERSPEED N2

P1A Pin	Fault Flag
39	HIGH TEMP OIL

(7) Depress fault flag RESET switch. Verify all four fault flags are cleared (not visible).

(8) Depress APU STOP switch.

(9) Place the APU MASTER POWER switch to the OFF position.

(10) Reinstall APU ECU (Ref. 49-00-02).

(11) Remove external electrical power (Ref. 24-41-00).

C 10. Rate Sensor Operational Check

C A. Whenever problems are suspected in the APU surge control system, for example, high duct pressure, the rate sensor check should be performed to determine if the APU can continue in operation for engine start.

C B. This test requires two people. One person must operate the APU control panel and the other must stand within 60 feet of the aircraft tail on the APU compressor inlet side of the aircraft.

C C. The APU shall be started and the control panel operator shall operate the APU in NORMAL mode with two ECS packs on, then shut one ECS pack off.

C D. The second person shall listen for surge, a distinct coughing or popping at a rate of 3 cycles per 1/2 second. If surging occurs, the test shall be stopped, and the APU placarded "Operate in MIN mode only for electric and ECS. Do not use to start engines". MCIMD and MCIEE are to be notified of the condition.

C E. If no surge is experienced, the operator will again operate the APU in NORMAL mode with two ECS packs on, then shut both packs off simultaneously. The second person will again listen for surge.

C F. Provided there was no load compressor surge noticed in the NORMAL mode check, repeat the checks again, this time with the APU selected to MAX mode.

C G. If there is no surge in NORMAL and MAX modes, then the surge
C control system is operating within limits and is considered
C serviceable.

AUXILIARY POWER UNIT (APU) - INSPECTION AND CHECK

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

	49-00-00	Airborne Auxiliary Power System - Maintenance Practices
	49-21-01	Auxiliary Power Unit (APU) - Servicing
	49-21-04	Oil Filter Element - Removal and Installation
	49-21-04	Oil Filter Element - Inspection and Check
	49-21-04	Oil Filter Element - Cleaning and Painting
R R	49-21-08	Engine Bleed Valve Air Filter - Removal and Installation
R	49-21-09	Engine Bleed Valve Multiple Connector - Servicing
	49-31-07	Fuel Filter Element - Removal and Installation
R R	49-31-22	FCU P3 Air Filter Element - Removal and Installation
	49-41-02	Ignition Exciter - Adjustment and Test
R R	49-51-20	IGV Control Air Filter Element - Removal and Installation
	49-51-21	Load Compressor Air Inlet Differential Pressure Switch - Removal and Installation
	49-51-23	Chip Detector - Removal and Installation
R R	49-51-27	Adjustable Orifice Filter Element - Removal and Installation

3. Inspection/Check

The APU maintenance inspections and checks are listed in Table 601

Inspection and Maintenance Actions
Table 601

INSPECTION/CHECKS	REFERENCE
A. Oil Level and Leakage Check	
(1) Check oil lines and connectors for leaks.	
(2) Observe the oil level and top off, if necessary, in accordance with Servicing instructions.	12-12-41
B. Audible Igniter Check	
WARNING: OUTPUT VOLTAGES GENERATED IN THE IGNITION SYSTEM EXCITER CAN CAUSE SERIOUS INJURY TO PERSONNEL. THE APU BAT BUS-IGNITION (CB3) CIRCUIT BREAKER SHOULD BE OPENED AND THE APU IGNITION RCCB (CB10) SHOULD BE MANUALLY TRIPPED TO ASSURE REMOVAL OF POWER FROM THE EXCITER. ALWAYS WAIT SEVERAL MINUTES FOR VOLTAGES IN THE EXCITER TO BLEED DOWN BEFORE WORKING ON THE HIGH TENSION PORTION OF THE IGNITION SYSTEM. ALWAYS DISCONNECT AND GROUND OUT THE HIGH TENSION HARNESS AT THE IGNITER BEFORE REMOVING THE EXCITER OR IGNITER.	
(1) Verify that MASTER POWER switch on the APU CONTROL panel, zone 215, is in the OFF position.	
(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker APU BAT BUS - IGNITION (S11).	
(3) On APU EQUIPMENT AND POWER CONTROL panel, zone 164, manually trip APU IGNITION RCCB (CB10). Verify that the RCCB ON flag does not show.	
(4) Disconnect one ignitor high-tension harness at the ignition exciter.	
(5) Close APU BAT BUS-IGNITION (CB3-S11) circuit breaker and reset APU IGNITION RCCB (CB10).	

Inspection and Maintenance Actions (Cont)
Table 601

INSPECTION/CHECKS	REFERENCE
(6) Perform dry motoring procedure while observer listens for sparking at ignitor.	49-00-01
(7) Repeat Steps (1),(2), and (3), then reconnect the high-tension harness disconnected in Step (4) and disconnect the other high-tension harness.	
(8) Repeat Steps (5) and (6).	
(9) Repeat Steps (1),(2), and (3), then reconnect the high-tension harness. Lock-wire both harness connectors.	
(10) Close APU BAT BUS-IGNITION (CB3-S11) circuit breaker and reset APU IGNITION RCCB (CB10).	
C. APU and Components Security	
(1) Check general security of the APU by inspecting all self-locking nuts for correct torque and checking all lock-wire for security.	
(2) Check harness mounting clips for security and signs of cable wear.	
(3) Inspect vibration mounts and platform attachment points for proper security.	
R (4) Visually inspect to ensure R approximately 1/2 inch clearance R exists between Surge Valve J-Tube and R generator hoist bracket bolts in R compartment ceiling. Also ensure R clearance exists between any other APU R component and compartment ceiling R blankets or structure.	
D. Fireseals	
(1) Check fireseals for cracks and security.	

Inspection and Maintenance Actions (Cont)
Table 601

INSPECTION/CHECKS	REFERENCE
E. Ducting and Shrouds	
(1) Inspect the exhaust shroud for distortion and cracks. Check shroud to outer fairing seals for general condition.	
(2) Check the exhaust, fan inlet air, and surge ducts for cracks around the flange areas and in the areas of sharp bends.	
F. Oil Filter Check	
(1) Remove oil filter element and inspect in accordance with the oil filter maintenance instructions. Clean or replace if necessary.	
G. Fuel Filter Check	
(1) Remove fuel filter element and inspect in accordance with the fuel filter maintenance instructions. Discard filter and install new element.	49-31-07
H. Platform Integrity Check	
(1) Visually check the platform for cracks, especially around the rivets. Check for missing rivets.	
(2) Check the vibration mounts for cracked brackets, extrusion of rubber from the top of the mount, and evidence of wear at the mounting plate to mounting base mating surface.	
(3) Visually check the rubber stripping that is bonded to the engine air inlet door for wear, fraying, or tearing.	
(4) Check the platform mount swing links for condition and no binding.	
I. Load Compressor Discharge Check Valve	

Inspection and Maintenance Actions (Cont)
Table 601

INSPECTION/CHECKS	REFERENCE
(1) Check condition of flappers, hinges, and seats. Inspect for cracks, wear, and evidence of binding.	49-51-16
J. Load Compressor Air Inlet Duct	
(1) Inspect load compressor air inlet duct for general condition and foreign matter. Inspect airflow guide vanes in the inlet duct elbow for cracks and separation from duct. Inspect load compressor rotor and inlet guide vane assembly for evidence of damage from foreign object injection.	49-51-25
K. APU Starter	
(1) Inspect APU Starter for evidence of overheat, oil ingress, and worn or damaged parts. Check brushes for excessive wear (minimum length of 0.625 inch) and specified brush pressure.	Overhaul Manual 49-41-06
L. APU Exhaust Muffler	
(1) Inspect exhaust muffler inner core for general condition of core pins, and the core structure for cracking and separation of the outer skin. (NOTE: The inner core may be permanently removed in accordance with SB 49-036.)	
M. IGV Air Filter	
(1) Remove filter element. Clean filter bowl and replace filter element in accordance with servicing instructions.	49-51-20
N. Differential Pressure Switch	
(1) Functionally check load compressor air inlet differential pressure switch.	49-51-21
O. Chip Detector	

Inspection and Maintenance Actions (Cont)
Table 601

	INSPECTION/CHECKS	REFERENCE
	(1) Inspect load hardware gearbox chip detector for metallic particles.	49-51-23
P.	IGV Control Adjustable Orifice Filter	
	(1) Replace adjustable orifice filter.	49-51-27
Q.	Engine Compressor Bleed Valve Air Filter	
	(1) Remove filter element. Clean filter bowl and replace filter element in accordance with servicing instructions.	49-21-08
R.	Engine Compressor Bleed Valve Orifices (Multiple Connector)	
	(1) Remove orifice block and clean orifices in accordance with servicing instructions.	49-21-09
S.	FCU P3 air filter	
	(1) Remove filter element. Clean filter bowl and replace filter element in accordance with servicing instructions.	49-31-22
T.	APU Starter Clutch	
	(1) Check oil level and replenish in accordance with servicing instructions	49-21-01
U.	Load Hardware Gearbox Assembly	
	(1) Inspect bleed air system for oil contamination whenever APU is replaced due to faulty lead seal in load compressor.	

CR AUXILIARY POWER UNIT - STORAGE INSTRUCTIONS

CR 1. General

CR A. Procedure for storage of the APU depends on the period of inactivity and whether or not the APU engine may be rotated during the inactive period. Follow the preservation schedules as outlined in following paragraphs.

CR NOTE: Do not spray preservation oil into compressor or turbine end of engine.

CR 2. APU System Preservation Schedules - Units Installed In Aircraft

CR A. 0 to 7 days.

CR (1) No action required

CR B. 8 to 28 days.

CR (1) Put desiccant in transition exhaust housing if humidity is 40 percent or higher.

CR (2) Close all APU openings with covers.

CR NOTE: Provide window in exhaust cover to observe humidity indications.

CR C. 29 to 90 days.

CR (1) Put desiccant in transition exhaust housing. Check and/or replace each 30 days.

CR (2) Close all APU openings with covers. Adhere to the NOTE in Paragraph 2B.

CR D. 91 days and over.

CR (1) Preserve the fuel system in accordance with Paragraph 3.

CR (2) Put desiccant in the transition exhaust housing. Check and/or replace each 30 days.

CR (3) Drain engine oil in accordance with Paragraph 4.

CR (4) Spray exposed accessory drive ends with oil in accordance with Paragraph 4A(6).

CR (5) Close all engine openings with covers. Adhere to the
CR NOTE in Paragraph 2B.

CR 3. Fuel System Preservation

CR A. The APU fuel system shall be preserved, prior to shipment,
CR or if the APU is to remain inactive for periods exceeding 28
CR days, as follows:

CR (1) Close the normal fuel supply shutoff valve. Disconnect
CR fuel inlet line to the APU fuel inlet and connect a
CR suitable oil supply line to the fuel pump or the oil to
CR fuel heater. Sypply lubricating oil, Military
CR Specification MIL-O-6081, Grade 1010 at a pressure of 5
CR to 25 psi and a temperature of 60 DEG F (15 DEG C)
CR MINIMUM.

CR CAUTION: EXTREME CARE MUST BE TAKEN TO PREVENT FOREIGN
CR MATERIAL FROM BEING DRAWN INTO THE ENGINE FUEL
CR SYSTEM. THE EQUIPMENT MUST BE PROVIDED WITH
CR SUITABLE FILTERS OR STRAINERS NO COARSER THAN 10
CR MICRON RATING.

CR (2) Loosen lines as required, to permit flushing oil
CR drainage into a suitable container in order to prevent
CR flushing oil from entering fuel manifolds. Disconnect
CR the fuel line at the engine dump and transfer valve.

CR CAUTION: UNDER NO CIRCUMSTANCES ALLOW OIL TO ENTER THE
CR ENGINE WHERE IT MAY COME IN CONTACT WITH THE
CR THERMOCOUPLE PROBE ASSEMBLY. OIL CONTAMINATION OF
CR THE HARNESS MAY CAUSE COMPLETE FAILURE OF THE
CR THERMOCOUPLE SYSTEM.

CR (3) With the ignition system off, normal fuel supply valve
CR closed, carry out normal 50 second motoring cycle using
CR the electric starter.

CR CAUTION: OBSERVE STARTER OPERATING LIMITS.

CR (4) After motoring run, check to see that the flushing oil
CR is coming from the dump valve line outlet. If not,
CR repeat motoring cycle until flushing oil flows from the
CR outlet.

CR (5) Following the motoring cycle, reconnect fuel delivery
CR lines to the unit.

CR 4. Oil System Preservation

CR A. The APU oil system shall be preserved, prior to shipment or if the APU is to remain inactive for periods exceeding 90 days, as follows:

CR (1) Close normal fuel supply shutoff valve and rotate engine with electric starter until oil pressure and compressor speed (NG) are indicated. Disengage starter.

CR (2) Drain all oil from engine oil tank accessory case gearbox and load hardware gearbox assembly.

CR (3) With drains open and engine ignitor circuit disconnected, motor engine over with starter to permit scavenge pumps to clear unit, indicated by cessation of steady stream of oil from drains. To prevent excessive operation with limited lubrication, limit rotation to shortest possible time to accomplish complete draining.

CR CAUTION: OBSERVE THE STARTER OPERATING LIMITS.

CR (4) Remove engine oil filter element and allow to drain.

CR (5) Allow APU oil to drain to a slow drip for approximately one-half hour. Install engine oil filter and close previously opened drains.

CR (6) Remove engine cover plates from pads of accessory drives not in use and spray exposed surfaces and gearshafts with engine lubricating oil. Replace cover plates.

CR (7) Install all plugs, caps, covers or screens over all openings to prevent entry of foreign material and accumulation of moisture.

CR (8) Tag oil filler cap with date of preservation.

ELECTRONIC CONTROL UNIT (ECU) - REMOVAL AND INSTALLATION

1. Referenced Procedures

20-31-01 Electronic Equipment Rack Front Holddown Extractor - Maintenance Practices

49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

R 49-75-02 Ng Indicator - Removal and Installation

2. Equipment and Materials

R Precision Tachometer or Frequency Meter (2800 Hz = 100 percent
R Ng)

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, open and tag the following APU POWER circuit breakers:

BAT PWR (B10)

CONTROLLER BUS 2 (B13)

CONTROLLER GND BUS (B14)

CONTROL & PRI F/W SOV - GND BUS (B15)

CONTROL & PRI F/W SOV - BUS 2 (B16)

(2) Gain access to the aft electronic equipment area (AEEA), zone 164, in aft cargo compartment. The APU electronic control unit is located on the bottom shelf
R of the AEEA rack.

(3) Disconnect static pressure line.

(4) Release holddown knobs and pull control unit from rack. (The ECU weight is approximately 13.5 pounds.)

(5) Inspect APU engine data plate for ECU Ng trim adjustment. If the data plate does not specify the number of turns from the full clockwise stop that the new ECU trim adjustment screw must be set to, determine

this setting by removing the protective cover on the removed ECU and count the number of turns required to set the adjusting screw to its full clockwise stop.

B. Installation

CAUTION: BE CERTAIN THAT ECU BEING INSTALLED IS COMPATIBLE WITH APU.

VISUALLY INSPECT ECU SUPPORT RACK FOR DISTORTION OR BOWING OF SUPPORT RACK PLATE. A BOWED PLATE CAN CAUSE MISALIGNMENT AND IMPROPER ENGAGEMENT OF ECU TO RACK ELECTRICAL CONNECTORS AND SHOULD BE REPLACED.

(1) Verify that circuit breakers opened in Step 3A(1) are opened and tagged.

(2) Place electronic control unit in rack and slide aft to engage electrical connectors.

NOTE: The control unit must be firmly seated in its support rack to assure full engagement of the J1 and J2 electrical interface connectors.

On aircraft 001-025,
theinboard knob is a torque control ratchet type which also serves as an extractor that aids in disengagement of the ECU to rack electrical connectors (Ref. 20-31-01). The outboard holddown knob is a threaded thumb screw knob. To provide a more positive engagement of the ECU to rack electrical connectors, this knob may be replaced in service by an extractor type knob identical to the inboard one. When installing an ECU, perform the Step 3B(3) procedure that is applicable to the holddown knob configuration.

(3) On aircraft 001-025,
engage the right holddown knob and tighten knob until it slips. Engage and tighten the left holddown knob. Using palm of hand, jar ECU aft and retighten both knobs in the same manner. Repeat as necessary to assure full engagement of the electrical connectors at the rear of the rack.

(3) On aircraft 026-033,
engage both ECU holddown knobs and alternately tighten both knobs until they slip. Using palm of hand, jar ECU aft and retighten both knobs. Repeat as necessary to assure full engagement of the electrical connectors at the rear of the rack (Ref. 20-31-01).

(4) Using an inspection mirror, inspect the aft end of the ECU and support rack for full engagement of the ECU to rack electrical connectors. ECU must be firmly seated in the rack with no bowing or distortion of the rack support plate or gaps in the ECU to rack electrical connector support.

NOTE: Electronic control unit Ng trim adjustment screws are preset in the shop for a preliminary trim speed of 37,500 rpm.

(5) Remove protective cover and set the new ECU Ng trim adjustment to the number of turns from the clockwise stop specified on the APU engine data plate. Lock adjustment screw and reinstall protective cover.

NOTE: Should engines become speed limited and this condition cannot be corrected by compressor washing then the ECU trim adjustment may be reset to a maximum limit of 38,100 RPM (full counter clockwise).

On ECUs with modified trim adjustment (adjustment stops eliminated), reset ECU per placard located adjacent to the adjustment knob.

If the APU engine data plate does not specify the ECU trim screw adjustment, the Ng trim setting may be determined by one of the following two methods.

(a) Set the trim adjustment screw to the same setting as removed ECU.

(b) Calculate the number of adjustment screw turns required from the full clockwise stop position using the procedure below.

NOTE: When adjusting the ECU trim screw the following torques will apply:

(a) Do not apply more than 8 inch-ounces against the stop.

(b) Lock trim screw shaft with lock nut finger tight. DO NOT TORQUE.

(c) Install trim screw access cover and retain with screws and washers, tighten finger tight, lockwire screws. DO NOT TORQUE screws or the cover will be damaged.

C (6) If the ECU trim adjustment screw setting is unknown C determine the correct trim setting using the following C procedure:

CR (a) Subtract 37,500 (controller preset RPM) from Ng C trim speed setting given on the APU engine data C plate.

C (b) Divide by 160 (change in trim speed per full turn C trim adjustment).

C (c) Remove protective cover and turn the trim C adjustment screw to the full clockwise stop, then C counterclockwise exactly the number of full turns C plus fraction of a turn determined in the C preceding step. Lock the adjustment screw and C reinstall protective cover.

C (7) Connect static pressure line.

C (8) Remove tags and close circuit breakers opened in Step C 2A(1).

C (9) Operate APU to check operation of ECU (Ref. 49-00-01).

C. Ng Uptrim Procedure

(1) Establish interphone communication between AEEA and flight station.

(2) Remove Ng indicator from APU CONTROL panel (49-75-02).

(3) Connect precision tachometer or frequency meter (2800 Hz equals 100 percent Ng) to Ng harness connector, pins 4 and 6.

C (4) Carefully turn ECU trim adjustment screw clockwise to C the minimum speed stop or a maximum of 10 turns.

(5) Operate the APU in MAX MODE, 3 ECS packs on, and an APU generator load of at least 45 KW.

NOTE: APU must be operating at speed limiting point. Verify this by checking IGV position (IGV's must be less than full open) or by slowly turning the Ng trim screw off the minimum stop. If APU is speed limiting, Ng should react to trim screw movement. If ambient temperatures are less than 20 degrees F, the APU may be developing enough power to be out of speed limiting and additional electrical load may be required.

(6) Once speed limited operation is verified, note Ng at the minimum speed trim setting.

(7) Calculate the number of trim screw turns required to raise the limiting speed to 38,100 rpm using the following equation:

No. of turns req'd = (38,100 - Ng (MIN)/160 where Ng (MIN) is the number of turns from the clockwise stop established in Step 3C(6).

(8) Set the trim adjustment screw to within 1/8 of a turn of the calculated turns setting.

(9) Check final trim speed. Under no circumstances should it be allowed to exceed 38,100 rpm.

(10) Tighten the trim screw jamnut just enough to assure retention of the adjustment, and reinstall the trim screw cover.

(11) Record adjustment in aircraft maintenance log and attach placard to ECU noting uptrim date and adjustment screw setting from clockwise stop.

(12) Reinstall Ng indicator (Ref. 49-75-02).

APU EQUIPMENT AND POWER CONTROL PANEL - REMOVAL AND INSTALLATION

1. Referenced Procedures

   20-24-04 Electric Bonding and Grounding Connections - LCP84-1027B

   49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

2. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers B(9) through B(17).

      (2) Gain access to the APU equipment and power control panel by opening access door to the AEEA, zone 164.

      (3) Disconnect wire number 2436-6A8 from terminal A of bus bar 2454-TB21.

      (4) Disconnect wire number 2436-7B8 from terminal A1 of CONTROLLER POWER RCCB 4961-CB9.

      (5) Disconnect the following wire harness connectors:

          9811J1530

          9811J1526

          9811J1527

          9811J1528

          9811J1525

      (6) Remove four panel support screws; one at each corner of panel and remove panel from aircraft.

   B. Installation

      (1) Verify that circuit breakers opened in Step 2A(1) are still opened and tagged.

      (2) Verify that electrical bonding path exists between panel and support brackets (four places). If not,

clean faying surfaces as required to establish electrical bond (Ref. 20-24-04).

(3) Mount panel in its installed position and secure panel to support brackets with four screws.

(4) Reconnect electrical harness connectors disconnected in Step 2A(5).

(5) Reconnect 2436-6A8 and 2436-7A8 wires disconnected in Step 2A(3) and (4).

(6) Verify that all tools used in replacing panel are removed from AEEA area. Close AEEA access door. R

(7) Remove tags and close circuit breakers opened in Step 2A(1).

(8) Operate APU to verify operation of equipment on new panel (Ref. 49-00-01).

VOLTAGE REGULATOR - REMOVAL AND INSTALLATION

1. General

APU control circuit voltage regulator 4961-VR1 is mounted on the lower right corner of the APU EQUIPMENT AND POWER CONTROL panel
R located in the AEEA, zone 164. The regulator is replaced in accordance with the following procedures.

2. Referenced Procedure

49-00-00 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel (CB3, zone 215, open and tag APU POWER circuit breaker. (B9 through B17).

(2) Gain access to the APU EQUIPMENT AND POWER CONTROL
R PANEL by opening AEEA, zone 164, access door.

(3) Record wiring numbers and corresponding terminal connections of panel wiring connected to voltage regulator terminal board. Disconnect wiring (Ref. Fig. 401).

(4) Remove four countersunk head regulator mount screws that pass through the regulator heat sink and into nut plates affixed to the aft side of the panel.

(5) Remove regulator, taking care to catch four spacers installed between regulator and panel.

B. Installation

(1) Verify that circuit breakers opened in Step 3A(1) are opened and tagged.

(2) Insert four regulator mount screws through the heat sink and install one spacer on each screw (Ref. Fig. 401).

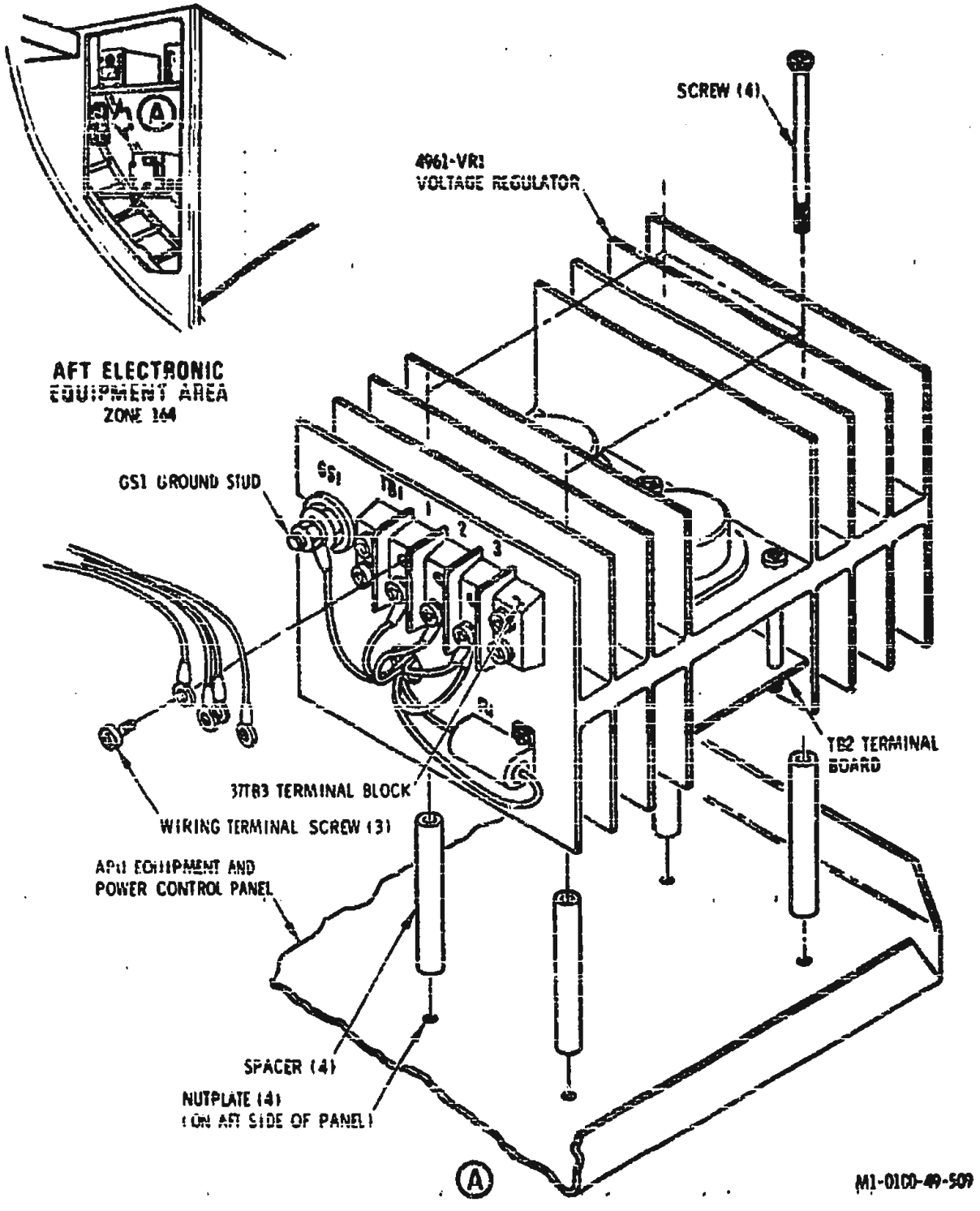
(3) Hold regulator in installed position and tighten screws to secure regulator to APU EQUIPMENT AND POWER CONTROL PANEL.

R (4) Connect wiring to terminal board attached to regulator
R heat sink.

R (5) Clear area of all tools and loose equipment and close
R AESC access door.

R (6) Remove tags and close circuit breakers opened in Step
R 3A(1).

R (7) Operate APU to check out circuit operation (Ref.
R 49-00-01).



R R Voltage Regulator - Removal and Installation
Figure 401

R R EFFECTIVITY: ALL

0018

R APU CONTROL PANEL - REMOVAL AND INSTALLATION

R 1. Referenced Procedures

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

R 24-41-00 External Power/Ground Service System - Maintenance
R Practices

R 2. Removal/Installation

R A. Removal

R (1) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag APU POWER circuit
R breakers (B9 through B14).

R (2) At Flight Engineers/Second Officers lower panel, zone
R 215, loosen four APU CONTROL panel captive fasteners
R and withdraw panel out of its installed position.

R (3) Disconnect electrical harness connectors and remove
R panel.

R B. Installation

R (1) Verify that circuit breakers opened in Step 2A(1) are
R opened and tagged.

R (2) Connect electrical harness connectors to receptacles on
R aft side of panel.

R (3) Insert panel into its installed position and secure
R panel by engaging captive fasteners.

R (4) Remove tags and close circuit breakers opened in Step
R 2A(1).

R (5) Apply external electrical power (Ref. 24-41-00) and
R verify operation of panel lights (Ref. 49-00-01).

R (6) Apply APU MASTER power and operate APU to verify
R functioning of panel circuitry (Ref. 49-00-01).

APU POWER PLANT - DESCRIPTION AND OPERATION

1. General

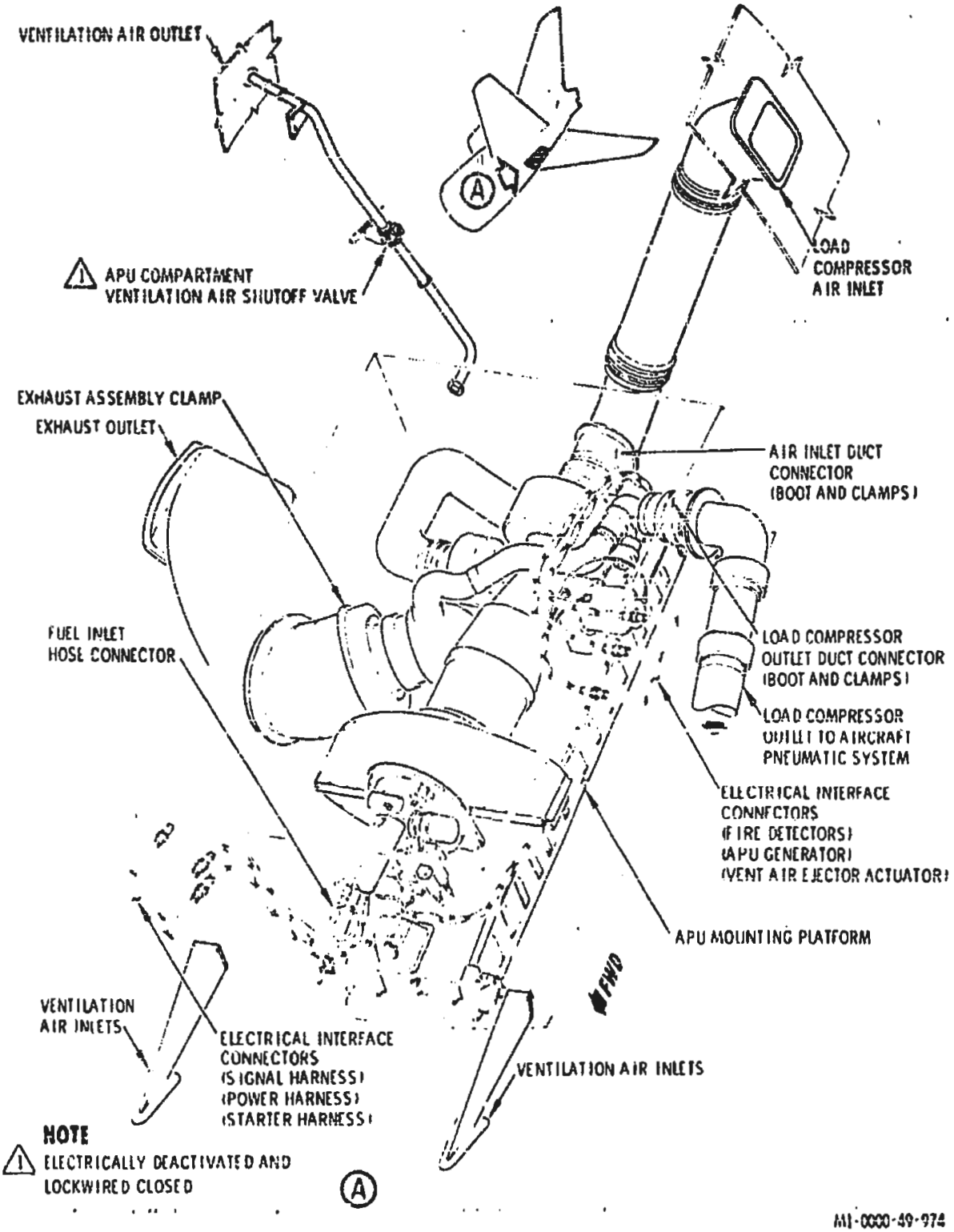
The APU power plant (Ref. Fig. 1 and 2) is a shop built-up assembly of the APU gas turbine engine, air load compressor, inlet guide vane assembly, electrical generator, air vent ejector, oil cooler, electrical wiring harnesses, and engine mounted accessories on a supporting platform. The assembled unit, when installed in a fire-proofed compartment in the aircraft afterbody section, requires only interface hookups to the aircraft fuel and pneumatic systems and aircraft wiring to become an operational auxiliary power unit. An APU exhaust assembly is mounted on the right wall of the APU compartment and is clamped to the engine exhaust transition duct during installation of the unit. Air load compressor inlet and outlet ports are mated to air inlet and outlet ducts installed in the afterbody structure by flexible boots and clamps. Fire protection is provided by metallic blankets which cover the compartment walls and ceiling and a fire detection and extinguishing system (Ref. 26-00-00).

Air used by the APU for combustion and internal cooling (Ref. Fig. 3) is admitted to the mounting platform through a fixed open air inlet door, where it is drawn into the gas generator compressor and cooling air section. Cooling air is directed by the
R fan to an engine cooling (piccolo) tube for external cooling of the gas generator case and into the exhaust system for cooling of the exhaust duct liner. A portion of this air is also directed overboard through the air-to-oil heat exchanger and vent air ejector. This airflow augments the flow of compartment ventilating air through the ejector.

R Compartment ventilation (Ref. Fig. 4) is provided by ram air
R which enters through two NACA type air scoops installed in the lower fuselage surface just in front of the APU compartment.

Ventilating air flows out of the compartment to the atmosphere through the electrically actuated air vent ejector doors. Air vent ejector doors are electrically closed whenever one of the two APU FIRE PULL handles is pulled or the APU autofire shutdown circuit is activated.

Access to the installed APU is provided by four hinged titanium access doors (Ref. Fig. 5) arranged in tandem on each side of the APU compartment. When closed, the doors are swung inward to latched positions against the APU mounting platform. Bulb type seals around the outer edges of each door flange seal the door to platform and afterbody structure mating surfaces.


VENTILATION AIR OUTLET
APU COMPARTMENT VENTILATION AIR SHUTOFF VALVE
LOAD COMPRESSOR AIR INLET
EXHAUST ASSEMBLY CLAMP
EXHAUST OUTLET
AIR INLET DUCT CONNECTOR (BOOT AND CLAMPS)
FUEL INLET HOSE CONNECTOR
LOAD COMPRESSOR OUTLET DUCT CONNECTOR (BOOT AND CLAMPS)
LOAD COMPRESSOR OUTLET TO AIRCRAFT PNEUMATIC SYSTEM
ELECTRICAL INTERFACE CONNECTORS (FIRE DETECTORS) (APU GENERATOR) (VENT AIR EJECTOR ACTUATOR)
APU MOUNTING PLATFORM
FWD
VENTILATION AIR INLETS
ELECTRICAL INTERFACE CONNECTORS (SIGNAL HARNESS) (POWER HARNESS) (STARTER HARNESS)
VENTILATION AIR INLETS
NOTE
ELECTRICALLY DEACTIVATED AND LOCKWIRED CLOSED
A
A

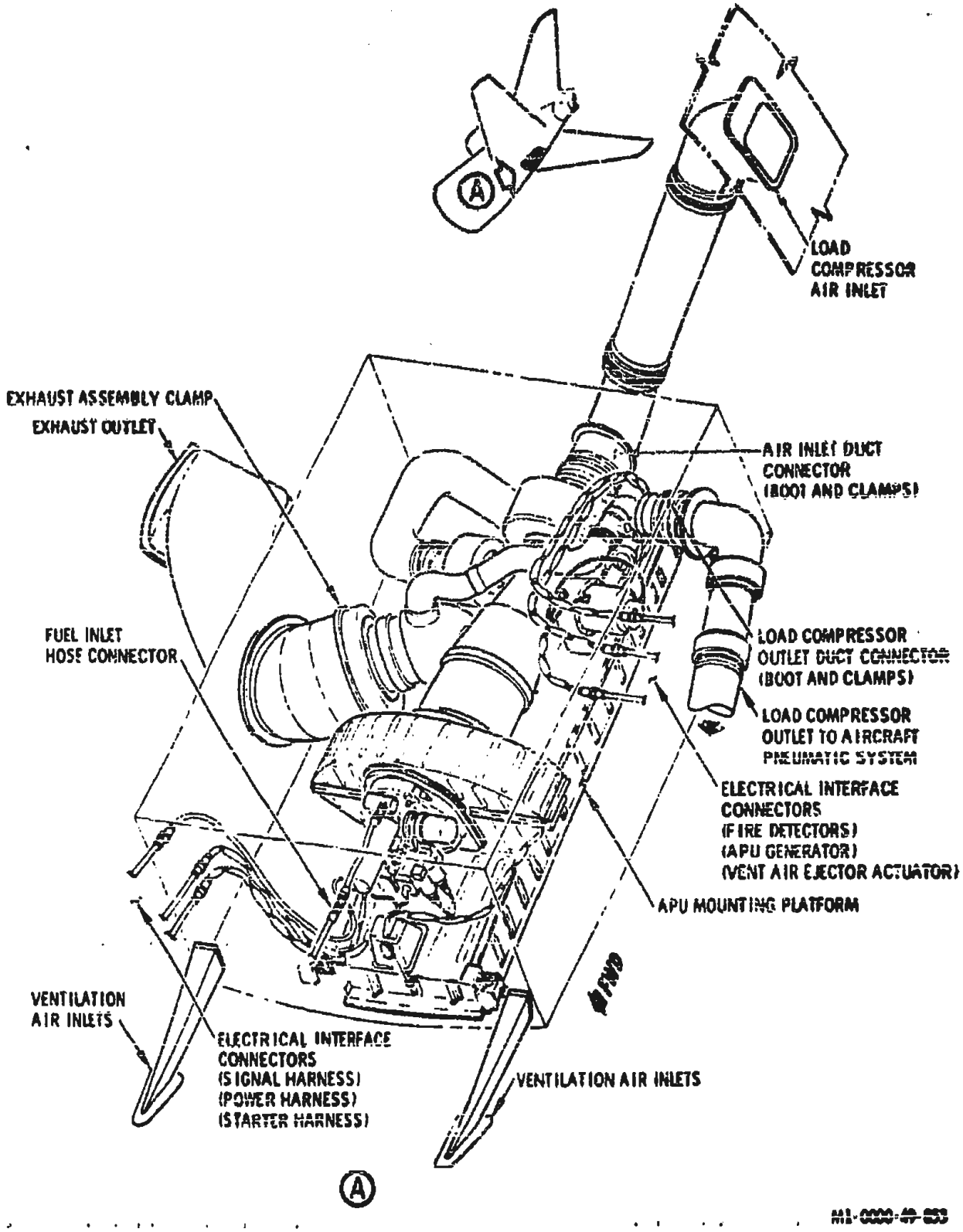
M1-0000-49-974

R
R

APU Power Plant Installation
Figure 1

EFFECTIVITY: 001-031

0028


LOAD COMPRESSOR AIR INLET
EXHAUST ASSEMBLY CLAMP
EXHAUST OUTLET
AIR INLET DUCT CONNECTOR (BOOT AND CLAMPS)
FUEL INLET HOSE CONNECTOR
LOAD COMPRESSOR OUTLET DUCT CONNECTOR (BOOT AND CLAMPS)
LOAD COMPRESSOR OUTLET TO AIRCRAFT PNEUMATIC SYSTEM
ELECTRICAL INTERFACE CONNECTORS (FIRE DETECTORS) (APU GENERATOR) (VENT AIR EJECTOR ACTUATOR)
APU MOUNTING PLATFORM
VENTILATION AIR INLETS
ELECTRICAL INTERFACE CONNECTORS (SIGNAL HARNESS) (POWER HARNESS) (STARTER HARNESS)
VENTILATION AIR INLETS
A
A

M1-0000-49-033

R APU Power Plant Installation
R Figure 1

Three spring-loaded blow-out doors installed in the right forward APU compartment access door function as differential pressure relief valves. The doors open outward to relieve compartment pressure whenever compartment internal-to-external pressure differential approaches 1 psid.

2. APU Mounting Platform

A. Description

The APU power plant is mounted on a box-shaped sheet metal platform (Ref. Fig. 6) and supported in the APU compartment by four support links (three swing links and one stationary link) at the corners of the platform structure. The lower surface of the platform conforms to the contour of the aircraft afterbody surface. When installed in the aircraft, the platform fills the central part of the compartment access area. The open areas provided for access to the compartment on each side of the platform are then covered by four hinged access doors. The lower half of the engine compressor air inlet plenum is mounted on the upper surface of the platform. Mounting pads for the engine support vibration mounts and an air inlet door actuator support are provided on the upper surface. Hoist attach provisions are located on each side of the air inlet plenum structure and
R at the aft end of the platform. An inward opening air inlet
R door, located in the platform lower surface, is fixed in the
R full open door position with the door actuator removed.

B. Operation

The APU mounting platform provides the passageway through which air is directed to the engine compressor air inlet plenum and cooling fan inlet duct.

3. APU Air Inlet Door Actuator

C Deleted by M. O. 99746

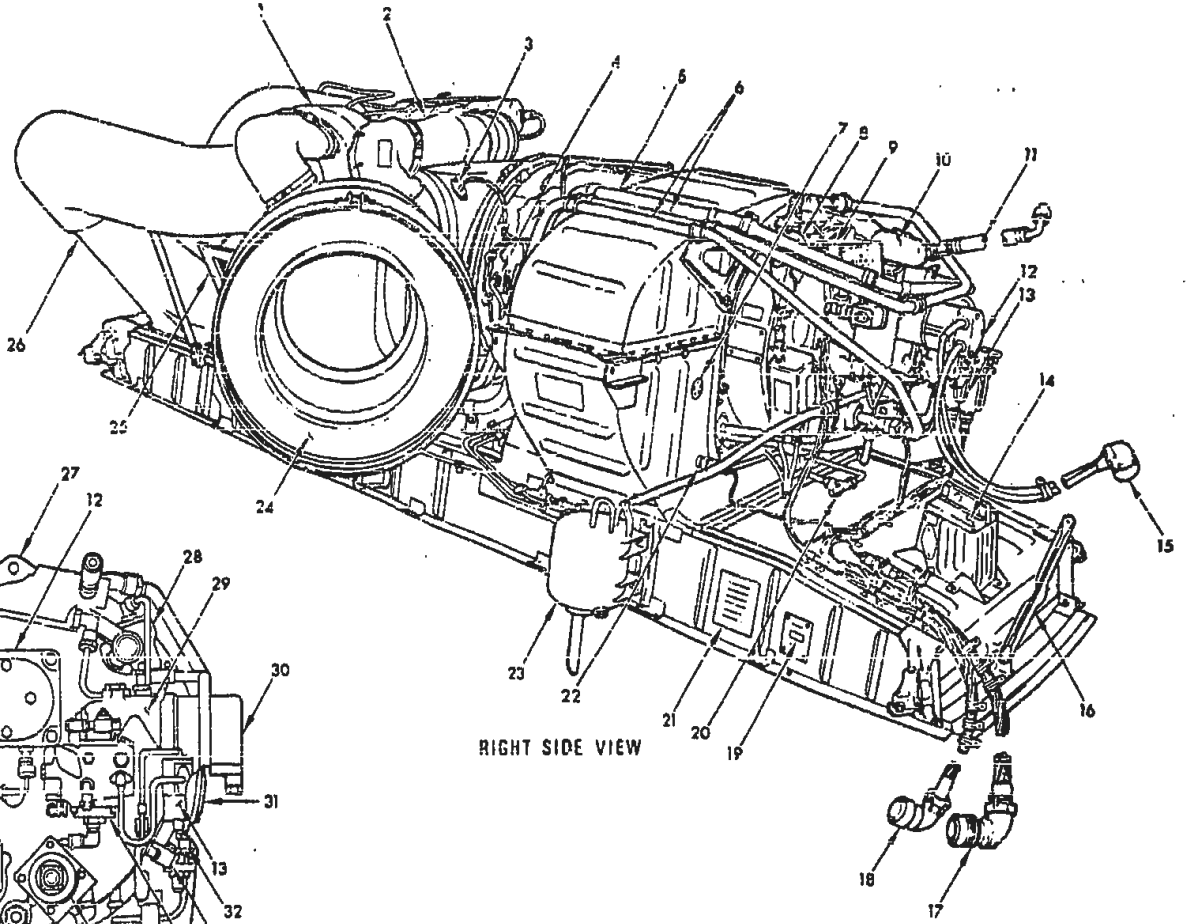
4. Air Vent Ejector

A. Description

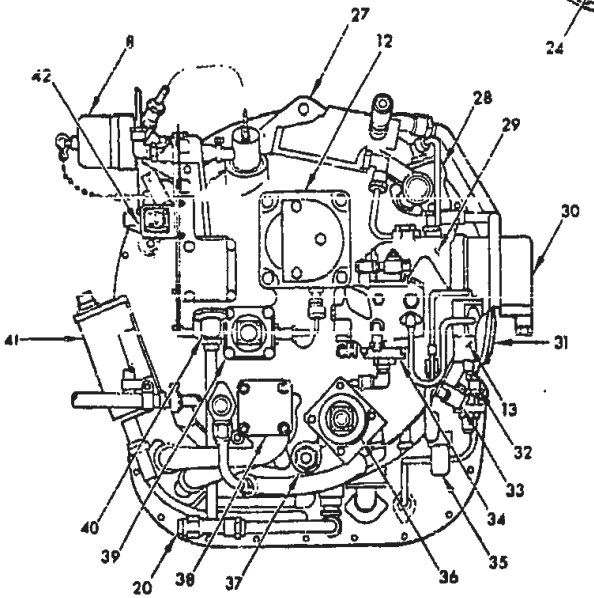
Ventilating airflow through the APU compartment is augmented by accelerating the airflow out of the compartment through an air vent ejector.

The air vent ejector (Ref. Fig. 9) consists of a rectangular duct having a converging inlet air nozzle and two

1 DUCT (COOLING AIR TO EXHAUST
2 SURGE DUCT
3 T17 THERMOCOUPLE (ONE OF TWO)
4 IGNITER PLUG (ONE OF TWO)
5 ENGINE BREATHER LINE
6 OIL LINES TO HEAT EXCHANGER
7 COMPRESSOR PLENUM INSPECTION COVER
8 OIL FILL PORT
9 OIL QUANTITY SIGHT GAGE
10 OIL-TO-FUEL HEATER
11 FUEL INLET HOSE
12 STARTER
13 AUTOMATIC FUEL SHUTOFF VALVE
14 AIR INLET DOOR ACTUATOR
15 STARTER HARNESS
16 PLATFORM GROUND STRAP AND SUPPORT CABLE
17 SIGNAL HARNESS
18 POWER HARNESS
19 APU DATA PLATE
20 OIL TANK AND SIGHT GAGE DRAIN FITTING
21 ENGINE MODIFICATION STATUS PLATE
22 T11 AIR INLET TEMP SENSOR
23 DRIP TANK
24 EXHAUST TRANSITION DUCT
25 OIL-TO-AIR HEAT EXCHANGER
26 COOLING FAN INLET DUCT
27 ENGINE HOIST BRACKET
28 OIL PRESSURE RELIEF VALVE
29 FUEL PUMP ASSEMBLY
30 FUEL FILTER
31 OIL FILTER
32 LOW OIL PRESSURE SWITCH
33 HIGH OIL TEMPERATURE SWITCH
34 FUEL CONTROL UNIT
35 FCU P3 AIR FILTER
36 GAS GENERATOR (Ng) TACHOMETER
37 ACCESSORY CASE OIL DRAIN PLUG
38 SCAVENGER OIL PUMP
39 FREE TURBINE SPEED CONTROLLER
40 OIL QUANTITY SWITCH
41 IGNITION EXCITER
42 ELAPSED TIME INDICATOR



RIGHT SIDE VIEW



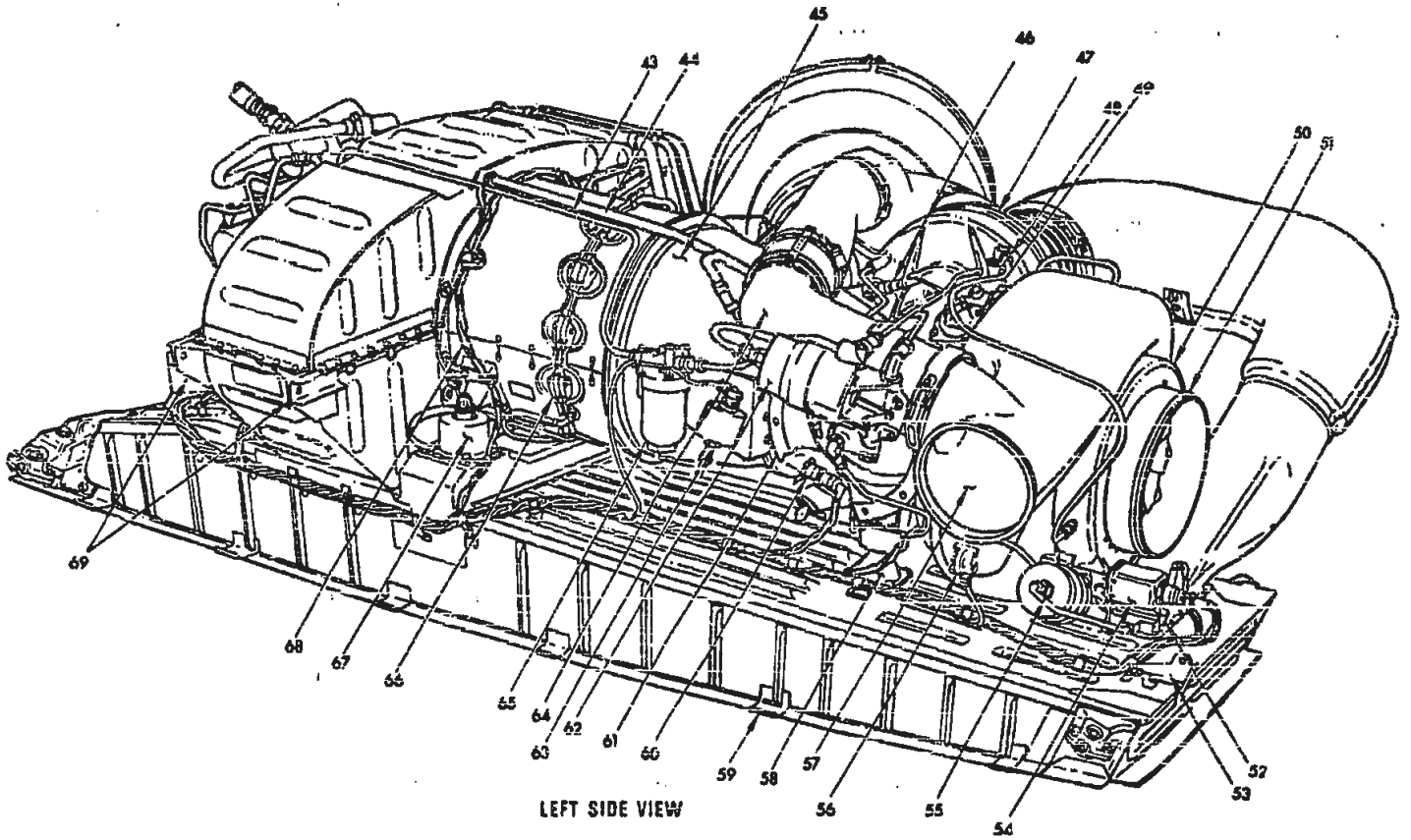
FORWARD VIEW

M-0001-49-715

Auxiliary Power Plant
Figure 2 (Sheet 1)

R
R
0028 EFFECTIVITY: ALL

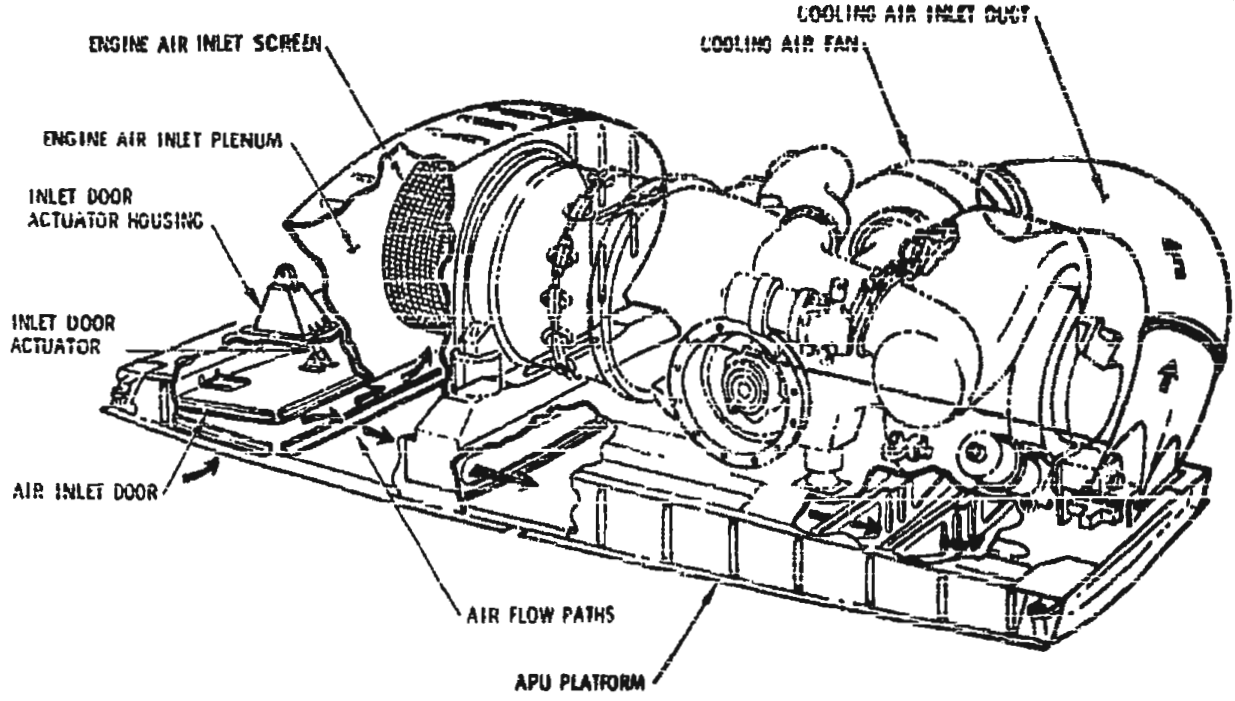
1-42 NOT SHOWN ON THIS SHEET
43 P3 AIR LINE
44 ENGINE COOLING (PICCOLO) TUBE
45 ENGINE POWER SECTION
46 NB FREE TURBINE SPEED SENSOR
47 COOLING FAN HOUSING
48 SURGE VALVE CONTROLLER
49 SHOCK SWITCH
50 INLET GUIDE VANE ASSEMBLY
51 LOAD COMPRESSOR AIR INLET
52 IGV POSITION TRANSDUCER
53 HOIST FITTING
54 LOAD COMPRESSOR CONTROLLER
55 INLET GUIDE VANE ACTUATOR
56 CURRENT TRANSFORMER
57 LOAD COMPRESSOR AIR OUTLET
58 FORWARD VIBRATION MOUNT (ONE OF TWO)
59 APU PLATFORM
60 NA FREE TURBINE SENSOR
61 GENERATOR MOUNTING PAD
62 SURGE VALVE
63 COMPRESSOR AIR INLET DIFFERENTIAL PRESSURE SWITCH
64 SURGE DUCT ELBOW
65 P3 FILTER
66 FUEL MANIFOLD
67 AFT VIBRATION MOUNT (ONE OF TWO)
68 ENGINE TEMPERATURE SENSING HARNESS
69 HOIST ADAPTER FITTINGS



LEFT SIDE VIEW

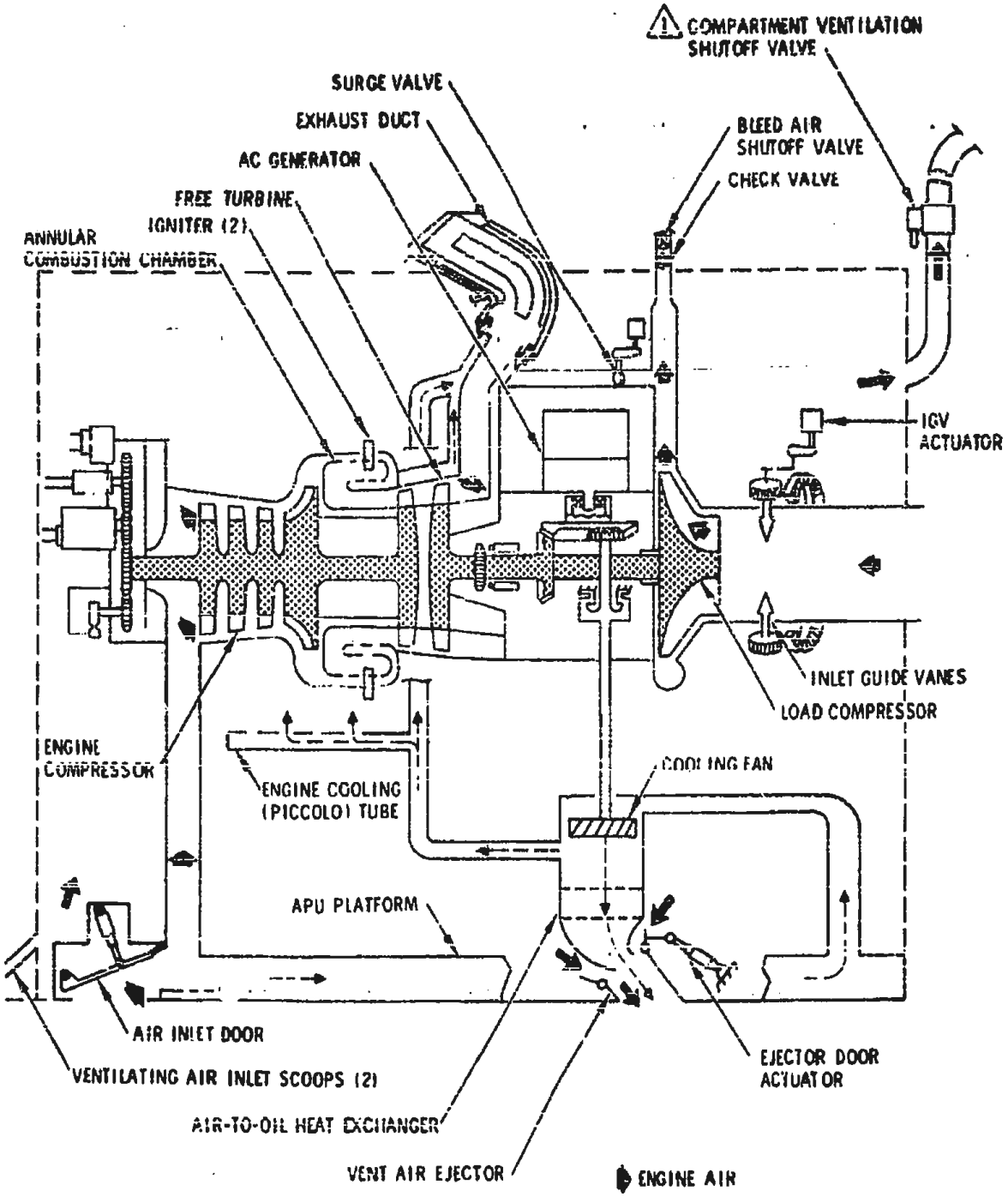
M1-0003-49-231

Auxiliary Power Plant
Figure 2 (Sheet 2)



M1-0101-49-015

APU Engine Air Inlet
Figure 3

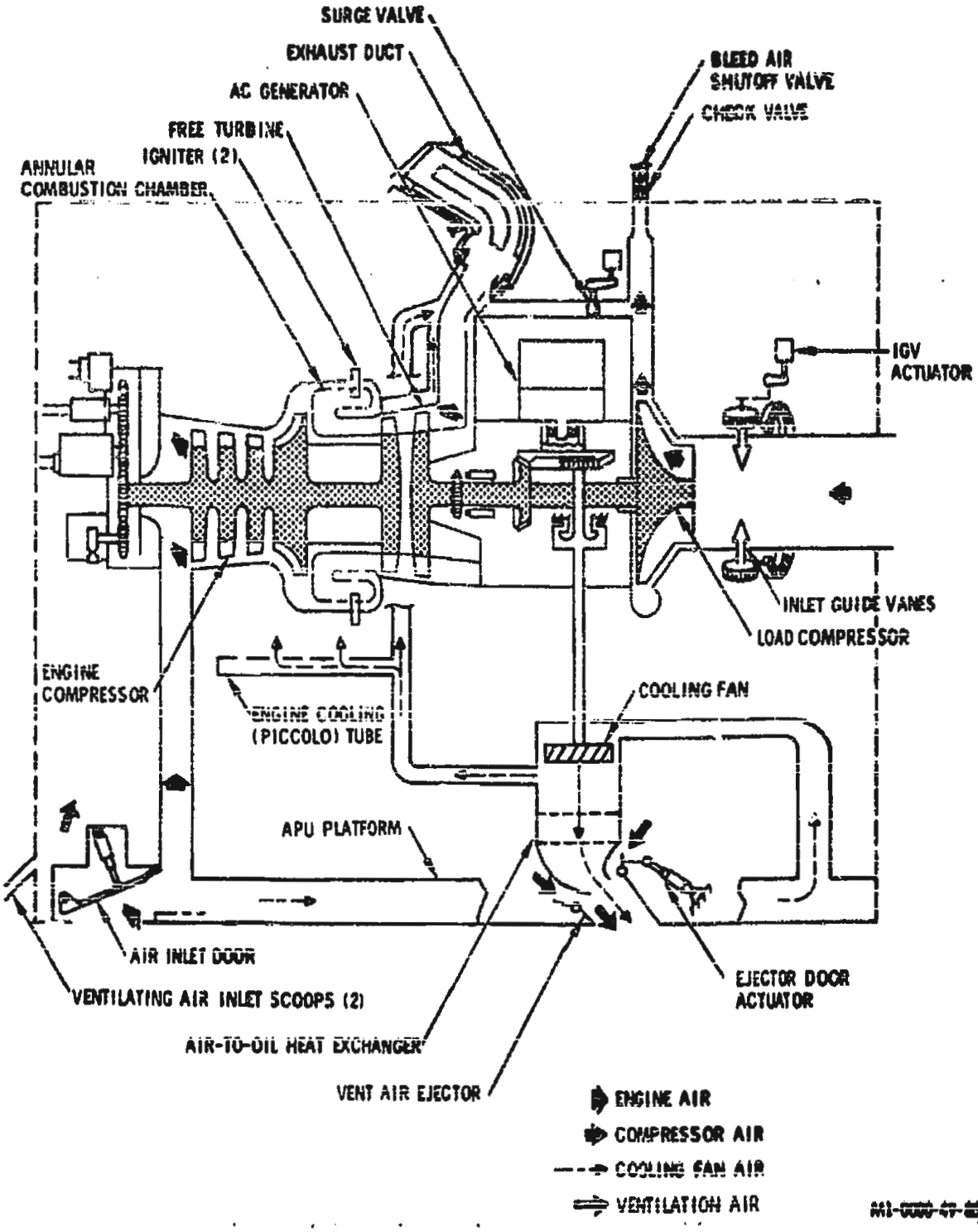


NOTE

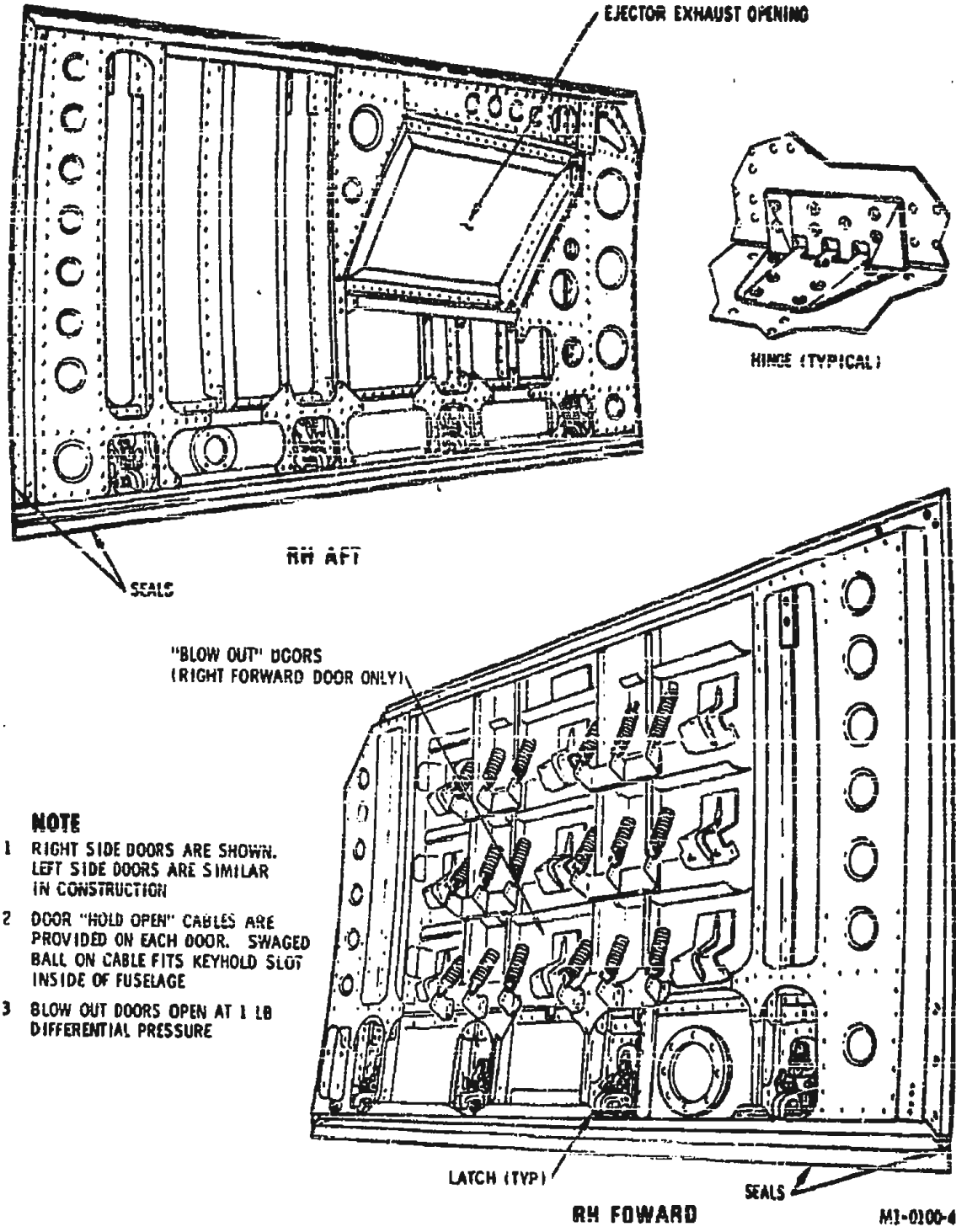
1 ELECTRICALLY DEACTIVATED AND LOCKWIRE CLOSED

R
R

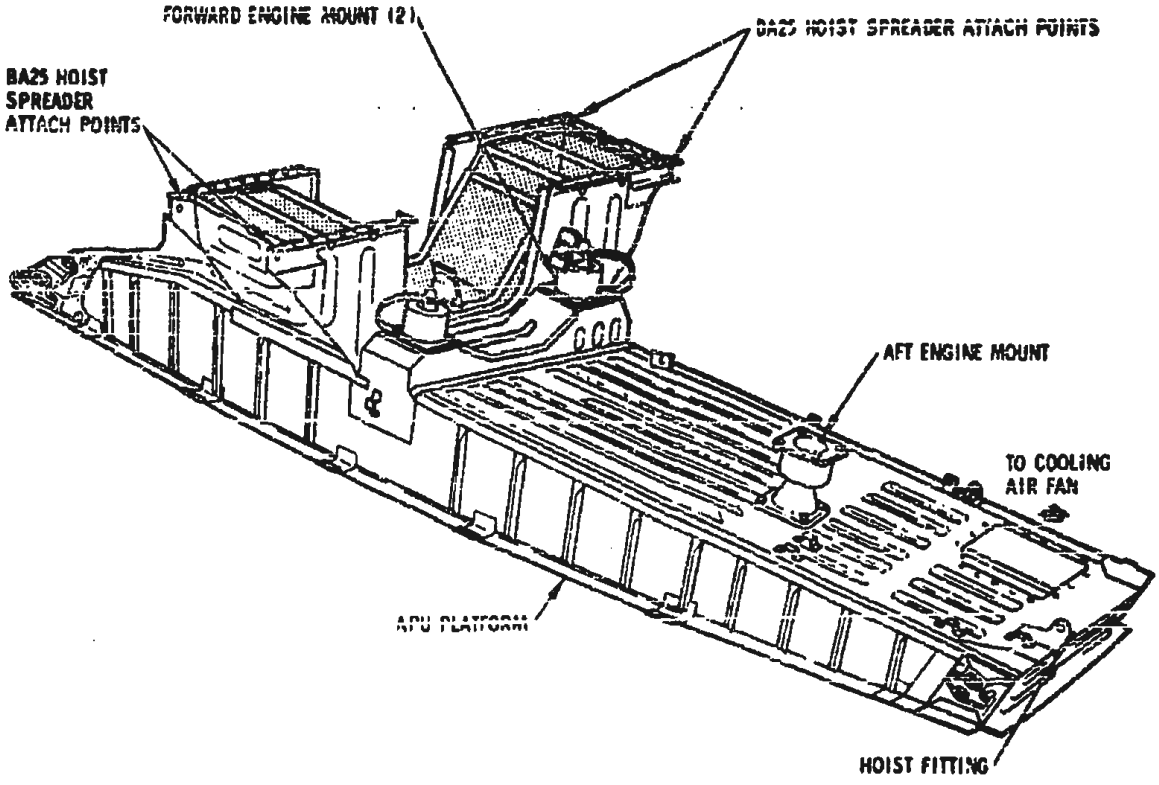
APU Airflow Diagram
Figure 4



APU Airflow Diagram
Figure 4

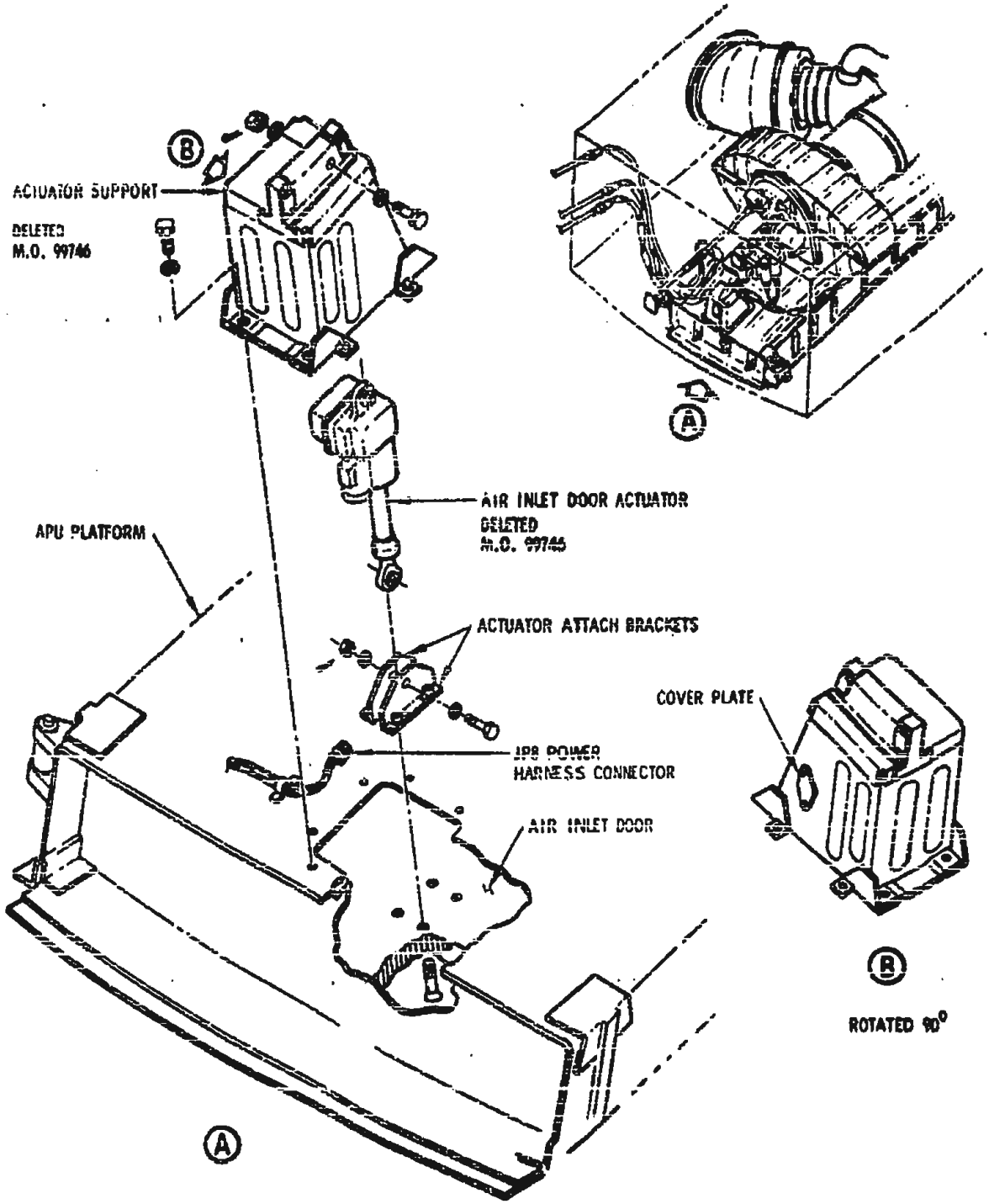

EJECTOR EXHAUST OPENING
HINGE (TYPICAL)
RH AFT
SEALS
"BLOW OUT" DOORS
(RIGHT FORWARD DOOR ONLY)
NOTE
1 RIGHT SIDE DOORS ARE SHOWN. LEFT SIDE DOORS ARE SIMILAR IN CONSTRUCTION
2 DOOR "HOLD OPEN" CABLES ARE PROVIDED ON EACH DOOR. SWAGED BALL ON CABLE FITS KEYHOLD SLOT INSIDE OF FUSELAGE
3 BLOW OUT DOORS OPEN AT 1 LB DIFFERENTIAL PRESSURE
LATCH (TYP)
SEALS
RH FOWARD
M1-0100-49-2XX

APU Compartment Access Doors
Figure 5

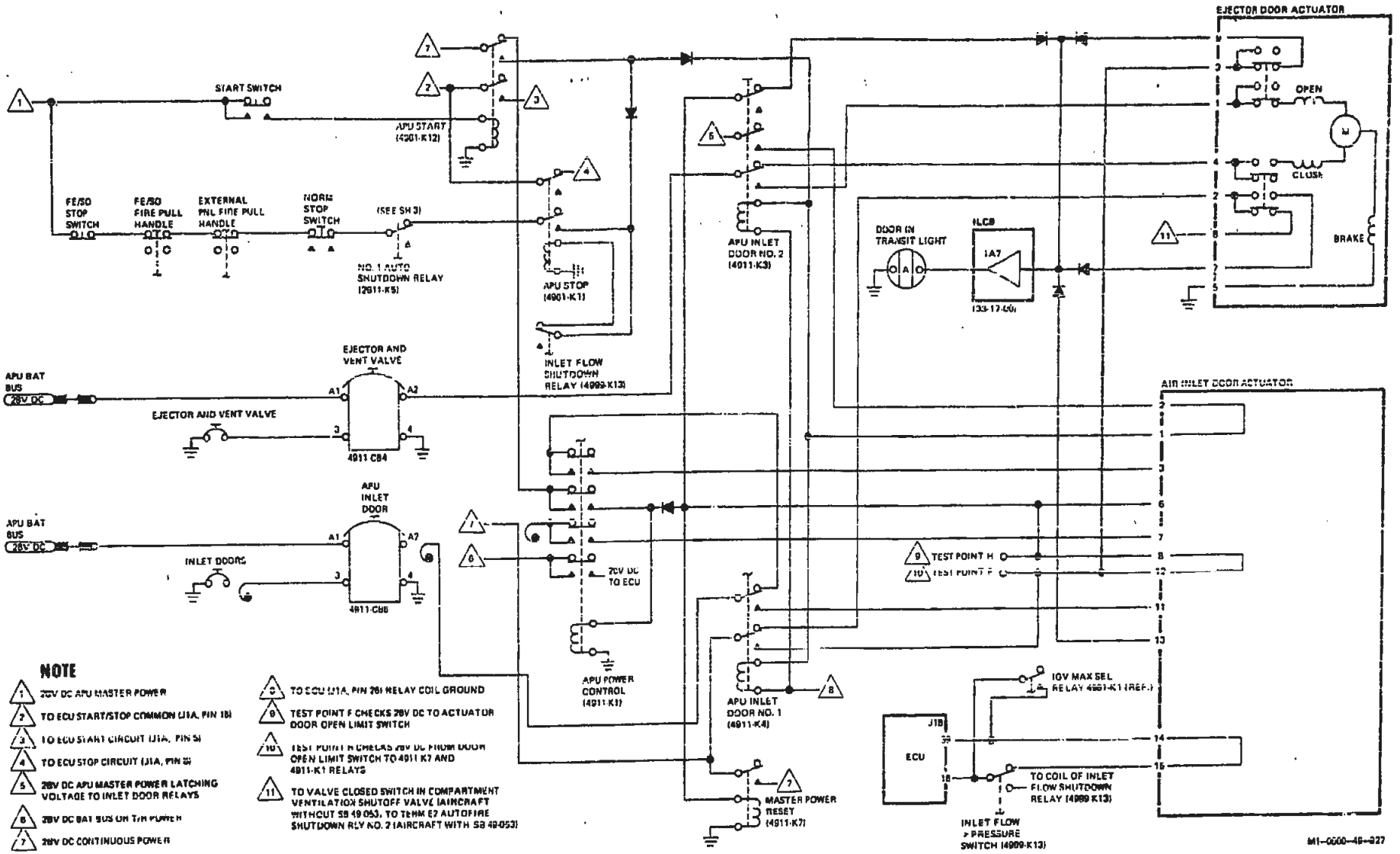


MI-0100-49-233

APU Platform
Figure 6



Air Inlet Door Actuator
Figure 7



NOTE

1. 28V DC APU MASTER POWER
2. TO ECU START/STOP COMMON (J1A, PIN 1B)
3. TO ECU START CIRCUIT (J1A, PIN 5)
4. TO ECU STOP CIRCUIT (J1A, PIN 3)
5. 28V DC APU MASTER POWER LATCHING VOLTAGE TO INLET DOOR RELAYS
6. 28V DC BAT BUS OR T/R PWR H
7. 28V DC CONTINUOUS POWER
8. TO ECU J1A, PIN 26 RELAY COIL GROUND
9. TEST POINT F CHECKS 28V DC TO ACTUATOR DOOR OPEN LIMIT SWITCH
10. TEST POINT H CHECKS 28V DC FROM DOOR OPEN LIMIT SWITCH TO 4911 K7 AND 4911-K1 RELAYS
11. TO VALVE CLOSED SWITCH IN COMPARTMENT VENTILATION SHUTOFF VALVE (AIRCRAFT WITHOUT SB 49-053). TO TERM E2 AUTOFIRE SHUTDOWN RLY NO. 2 (AIRCRAFT WITH SB 49-053)

R R Air Inlet and Vent Ejector Door Schematic Diagram
Figure 8

EFFECTIVITY: ALL

002B

rectangular ventilating air inlet doors. The doors are operated to open and closed positions by an electrically operated actuator mounted on the side of the ejector exit duct. An engine breather hose is connected to a standpipe attached to the duct upper surface. The assembly is mounted at the outlet of the oil-to-air heat exchanger at the aft right corner of the APU platform. Combined engine oil cooling, engine breather, and compartment ventilating airflow is discharged overboard from the ejector duct through an opening in the right aft APU access door. Compartment ventilating air enters the ejector through two rectangular slots in the upper and lower surfaces of the ejector duct at the cooling air inlet nozzle. The ventilating air inlet doors are hinged at the edges of the slotted areas and are normally open whenever the APU is operating.

B. Operation

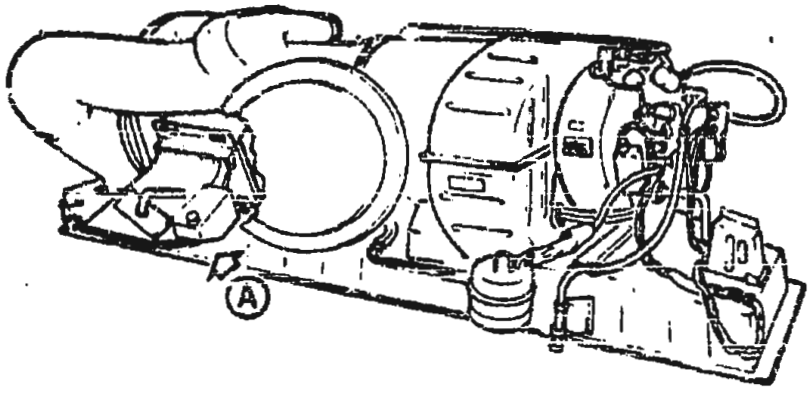
When the air vent ejector doors are open, ventilating air is drawn into the ejector duct by the jet pump effect created by air from the cooling fan flowing through the oil-to-air heat exchanger and ejector nozzle. The combined ventilating and engine oil cooling airflows are directed overboard through the ejector duct.

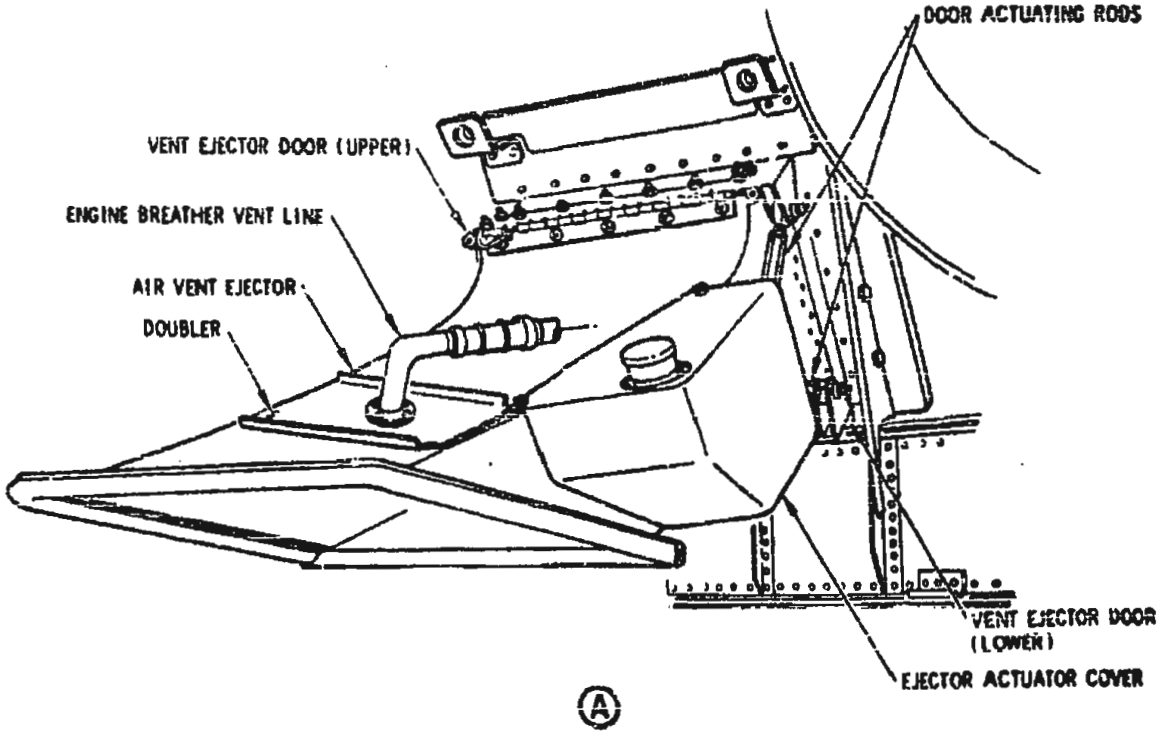
5. Air Vent Ejector Door Actuator

A. Description

The ventilating air inlet doors on the air vent ejector are opened and closed by an electrically operated linear actuator (Ref. Fig. 9 and 10). Enclosed in the actuator housing is a reversible dc motor and magnetic brake assembly, a gear train containing a spring loaded clutch, and a rotating nut driven jackshaft. Electrical power to the motor and brake assembly is controlled by internally mounted extend and retract limit switches which are mechanically actuated at the jackshaft full extend and retract positions. Other contacts in these switches apply electrical power to the DOOR IN TRANSIT light indicating circuit during the actuator extend and retract cycles and provide partial arming of the APU autofire extinguishing system control relay circuit (Ref. 26-21-00).

An integral end fitting on the actuator housing is used to pivot mount the actuator to a support fitting on the side of the ejector duct. The jackshaft end of the actuator supports a T-shaped clevis to which is attached the two door operating links.





MI-0100-49-002

Air Vent Ejector
Figure 9

B. Operation

With the actuator in the fully retracted (door closed) position, the door closed limit switches are open and the door open limit switches are closed (Ref. Fig. 8). When the APU START button switch is depressed, the AIR INLET DOOR NO. 1 and NO. 2 relays are energized. Power is applied through the energized AIR INLET DOOR NO. 2 relay and door open limit switch to the actuator motor and brake. The brake releases and the motor extends the jackshaft to open the ventilating
R air doors. A 28V dc circuit that applies 28V dc to the
R DOORS IN TRANSIT light through the APU INLET DOOR NO. 1
R relay and actuator door open limit switch is maintained
R until the door is fully open. As the jackshaft begins to
R extend, the door closed limit switches arm the actuator for
R a door closed operation and open a circuit that applies 28V
R dc from APU INLET DOOR NO. 1 relay to the autofire shutdown
R circuit.

When the jackshaft in fully extended (ventilating doors open) the door open limit switches in the actuator are mechanically opened and power is removed from the actuator motor and brake. The brake engages, stopping further motor rotation, and the DOOR IN TRANSIT light circuit is opened.

A door closed operation is initiated when the air inlet door relays are deenergized. DC power is applied through the deenergized AIR INLET DOOR NO. 2 relay and the door closed limit switch to the actuator motor and brake. The DOOR IN TRANSIT light circuit is completed through a second set of contacts in the door closed limit switch.

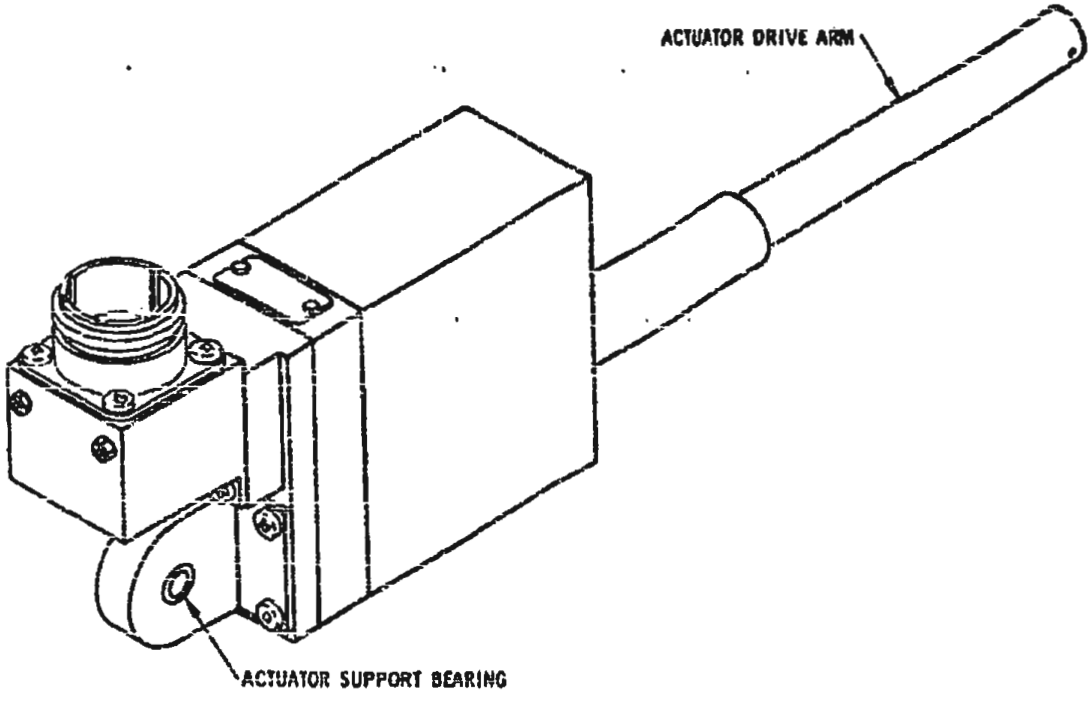
As the actuator jackshaft begins to retract (doors closing), the door open limit switch is mechanically closed and the actuator is armed for another door open cycle.

When the jackshaft is fully retracted, the door closed limit switch removes power from the actuator motor and brake. The brake engages and the motor stops rotating. At the same
R time the DOORS IN TRANSIT light circuit is broken and 28V dc
R power is applied to terminal E2 the No. 2 autofire shutdown
R relay.

R 6. APU Compartment Ventilation Shutoff Valve

A. Description

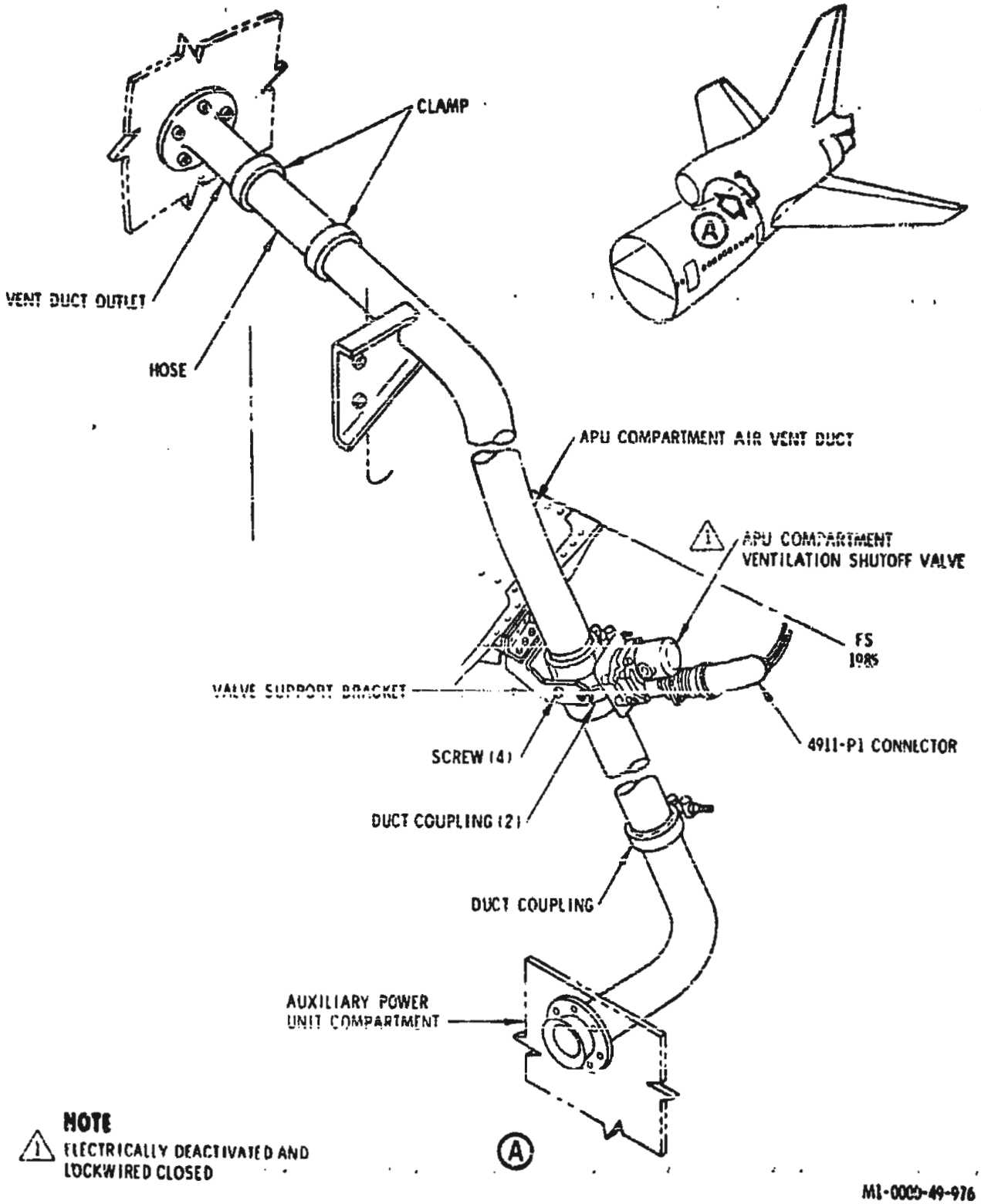
The APU Compartment Ventilation Shutoff Valve is electrically deactivated and lockwired closed (Ref. Fig. 11 and Fig. 12).



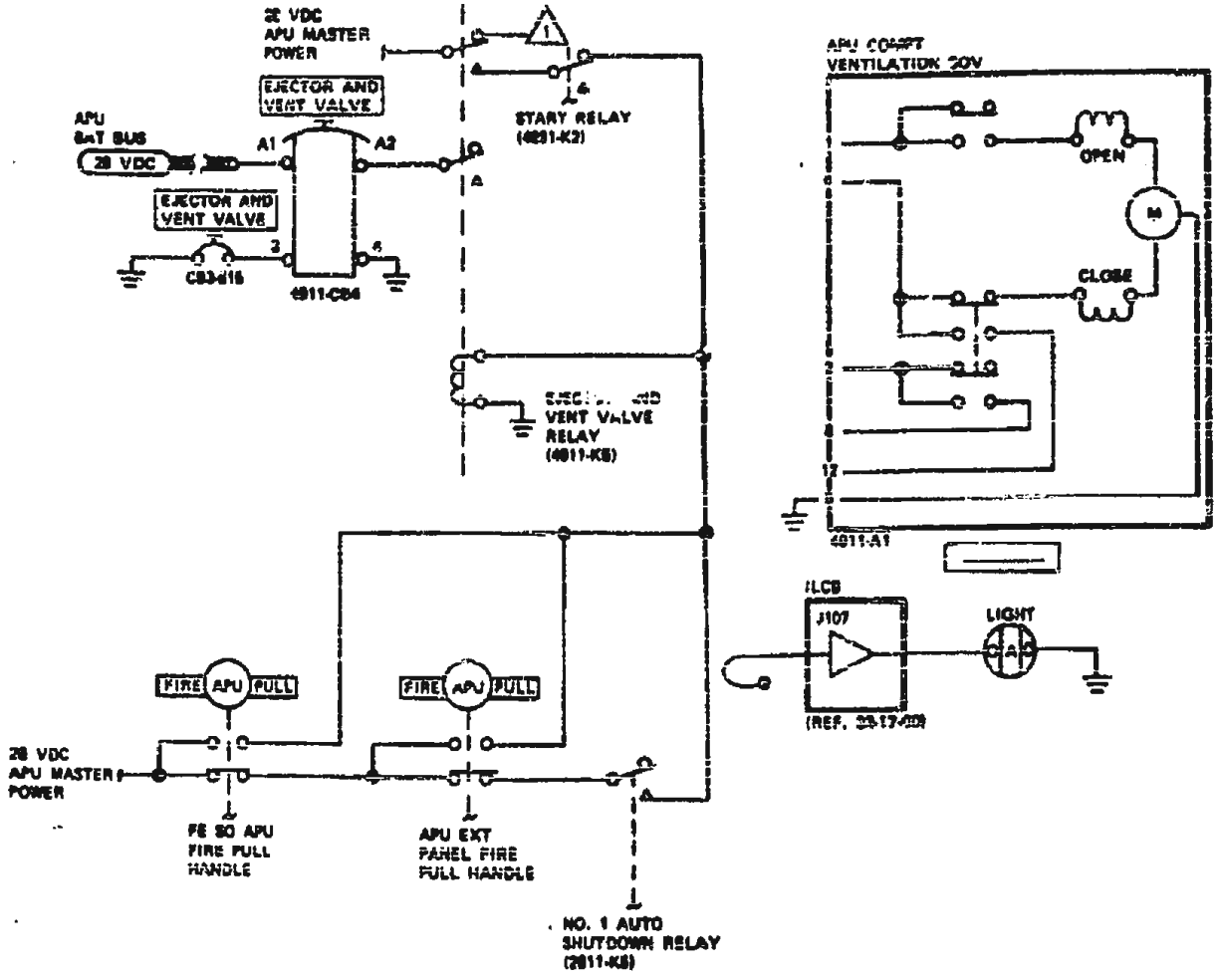
NOTE
ACTUATOR SHOWN IN EXTENDED POSITION

MI-001-49-002

Air Vent Ejector Door Actuator
Figure 10



APU Compartment Ventilation Shutoff Valve
Figure 11 (Sheet 1)



NOTE

1. TO COIL OF APU PRIMARY FIREWALL SOV RELAY (4911-K5).

Ventilation Shutoff Valve Schematic Diagram
Figure 12

7. APU Wiring Harnesses

Wiring to electrically controlled and operated components on the APU, exclusive of wiring to the APU generator, current transformer, and air vent ejector door actuator, is grouped together in two wiring harnesses and interfaced with the aircraft wiring by two quick disconnect connectors on the forward wall of the APU compartment. Individual electrical connectors at various locations in the harness routing are identified by reference designators on sleeving installed just behind each connector. JP designators identify a power harness connector; JS, a signal harness connector.

The signal wiring harness (Ref. Fig. 13) includes wiring to components that transmit input signals to or are operated under the guidance of signals received from the ECU.

The power wiring harness (Ref. Fig. 14) includes the wiring to components that are not directly interfaced with the ECU. These components are controlled by switches and relays in the APU circuits or provide input signals to flight station APU status indicators not affected by ECU logic.

Harness connectors JS9 and JP9 interconnect the load compressor air inlet differential pressure switch wiring with the power and signal harnesses.

A separate two wire harness connects the APU starter to a quick disconnect connector on the forward wall of the APU (Ref. Section 49-41-00). The air vent ejector door actuator is connected by a separate wire bundle (W1) to a connector (3332-P1) on the aft right wall of the APU compartment next to the APU generator and current transformer wiring connectors.

8. APU Compartment Drain Provisions

A. Description

Due to the slope of the installed APU mounting platform and the APU compartment doors, fluids leaked into the compartment will flow forward and collect in a pool along the platform-to-fuselage bulkhead mating flange at FS 1885. This fluid is drained to the atmosphere through a drain mast.

The drain mast, comprised of a 13-inch long airfoil shaped tube and a mounting flange, is attached to the fuselage skin at FS 1834 (BL 39). Two drain tubes are routed through the assembly and held rigid by plastic urethane foam which fills the core of the mast. The forward drain tube is connected to a tubing installation which is routed aft to a bulkhead

fitting exposed to the fluid collection area in the APU compartment. The aft drain tube is connected to a tubing installation which is routed to a fitting in the No. 2 engine fuel line shroud just aft of the cabin pressure bulkhead.

B. Operation

The APU mounting platform to fuselage mating flange at the most forward end of the platform, being the lowest area in the APU compartment, is a bilge where any uncontained fluid in the compartment will collect in a pool. This fluid will normally flow forward through a drain line and overboard through the drain mast. In flight, extraction of fluid from this area is augmented by the negative pressure created by air flowing past the scarfed end of the mast.

9. APU Power Plant Drain Provisions

A. Description

Fluids drained from the APU combustion chamber, flow divider and dump valve, cooling fan housing and generator drive pad, and the fuel pump and starter drive pads is collected in a drip tank mounted on the right side of the mounting platform (Ref. Fig. 15). The tank contains two standpipes. One is exposed to the bottom of the tank and is routed upward out of the tank and then back through the center of the tank into an overboard drain tube. The second standpipe is a projection of the overboard drain tube. The upper end of this pipe is open to the tank at a level sufficient to contain the fluids accumulated from three false and one successful APU starts. A drain plug at the bottom of the tank permits manual draining of the tank.

B. Operation

The primary purpose of the drip tank is to prevent overboard dumping of fuel onto the ground during starting and stopping of the APU. However, if sufficient fluid is allowed to collect in the tank, fluid will flow overboard when its level is high enough to enter the overboard drain standpipe. This is normally prevented by manual draining of the tank. In flight, the tank is evacuated by the negative pressure created by the flow of air past the scarfed end of the drain pipe.

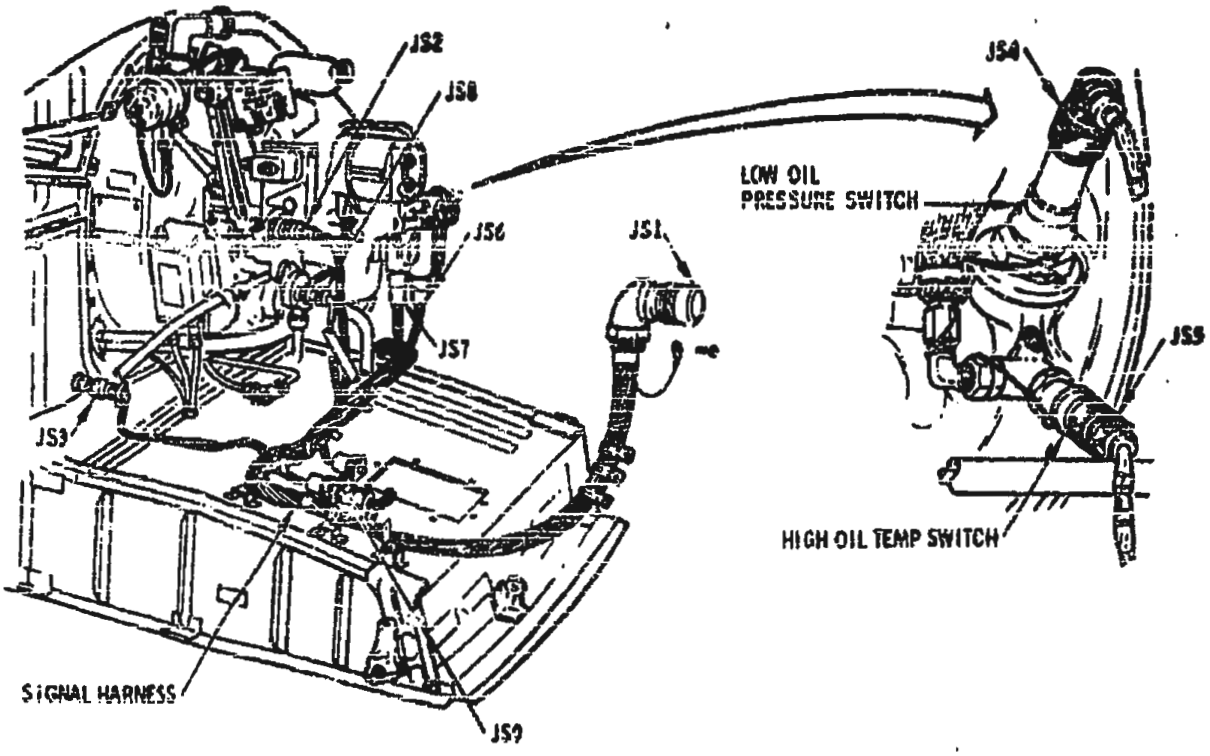
10. Fluid Diversion Scupper Installation

A. Description

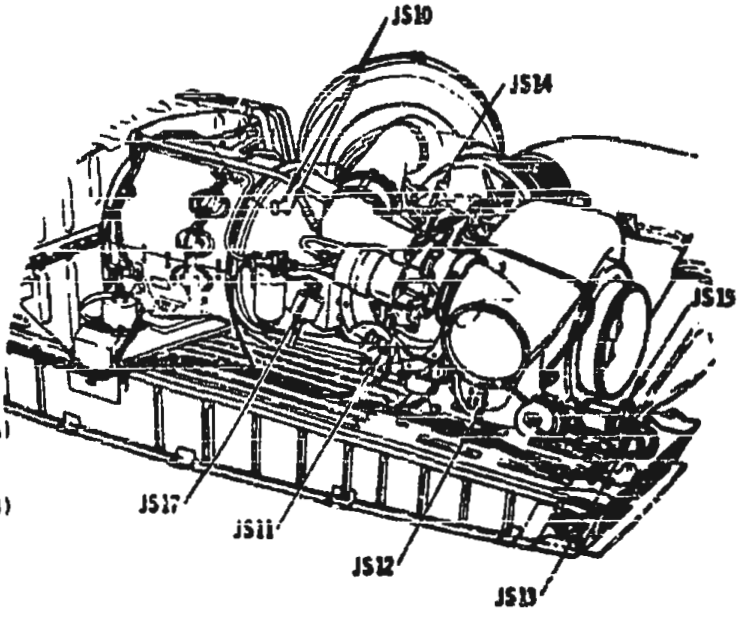
The ingestion of fluids seeping along the fuselage undersurfaces and into the APU engine air inlet is a major cause of APU engine compressor contamination and the resulting deterioration in APU performance. To divert these fluids from the engine air inlet, a fluid collecting scupper consisting of half-round strips of metal, is attached to the platform lower surface around the engine air inlet opening and on the fuselage surface just forward of the APU compartment in the form of a V-shaped chevron.

B. Operation

Fluids collecting in the platform scupper strips flow forward through a square shaped trough to the chevron shaped scupper on the fuselage surface. The chevron diverts the fluid outboard where it can drip free of the aircraft or, when airborne, be blown clear of the APU engine air inlet along with any other fluids being carried aft along the fuselage by the boundary layer airflow. To permit opening of the left forward APU compartment access door and removal-installation of the APU platform, the interface gap between the APU platform and the chevron shaped connecting trough is bridged by a hinged spring-loaded fluid catcher. The catcher is manually swung forward to permit opening of the left forward APU compartment access door and must be restored to its flush position against the scupper on the platform when the door is closed.

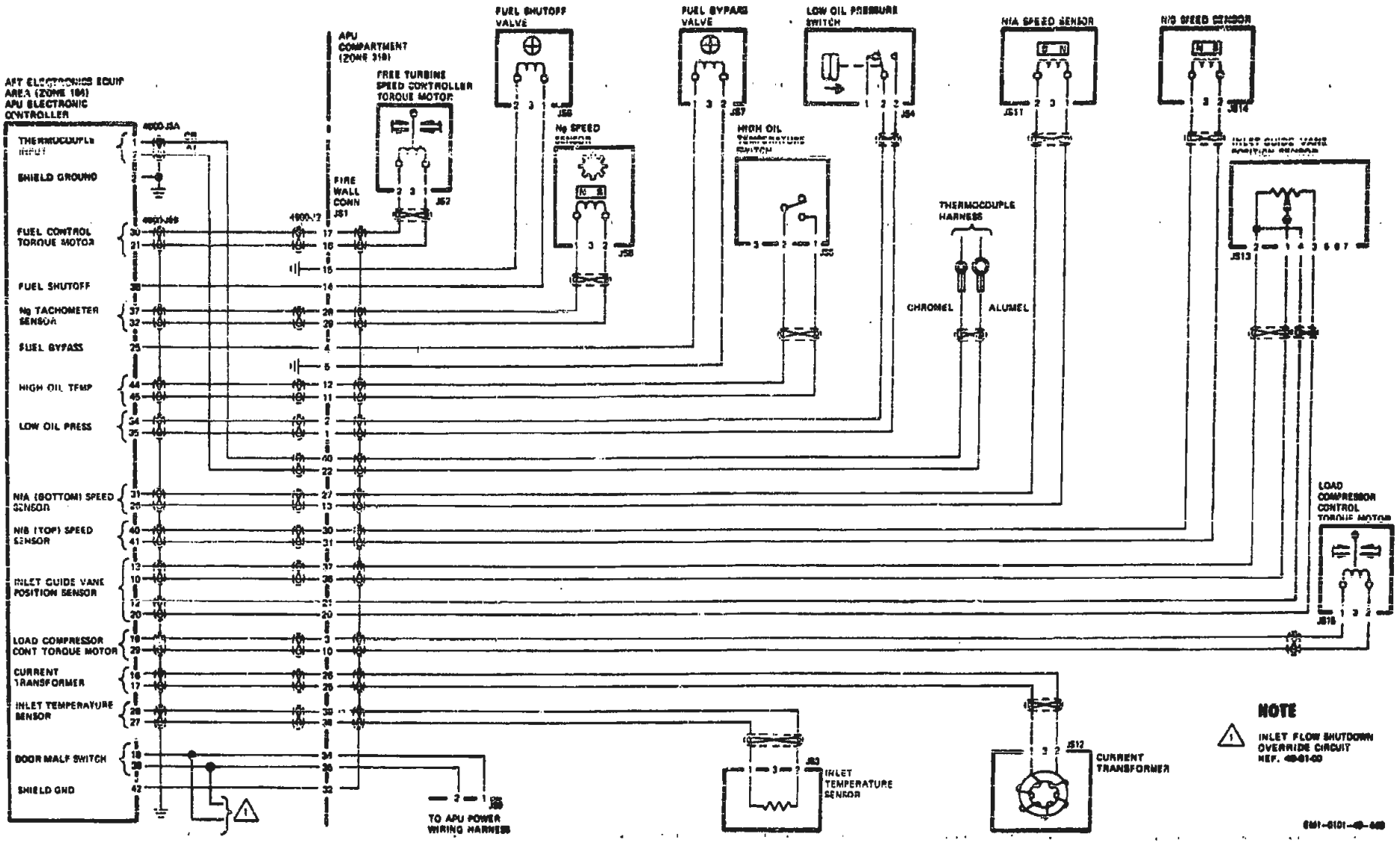


CONNECTOR DESIGNATION	SIGNAL HARNESS CONNECTOR
JS1	FIREWALL CONNECTOR (SIGNAL)
JS2	FREE TURBINE SPEED CONTROLLER (N_f SPEED)
JS3	INLET TEMPERATURE SENSOR
JS4	LOW OIL PRESS. SWITCH
JS5	HIGH OIL TEMP SWITCH
JS6	FUEL SHUTOFF VALVE SOLENOID
JS7	FUEL BYPASS VALVE SOLENOID
JS8	GAS GENERATOR TACHOMETER
JS9	ΔP HARNESS TO SIGNAL HARNESS INTERCONNECT
JS10	T_1, T_3, T_7 TEMPERATURE SENSING HARNESS (TGT)
JS11	FREE TURBINE SPEED SENSOR (N_fA)
JS12	CURRENT TRANSFORMER
JS13	IGV FEEDBACK TRANSDUCER
JS14	FREE TURBINE SPEED SENSOR (N_fB)
JS15	LOAD COMPRESSOR CONTROLLER



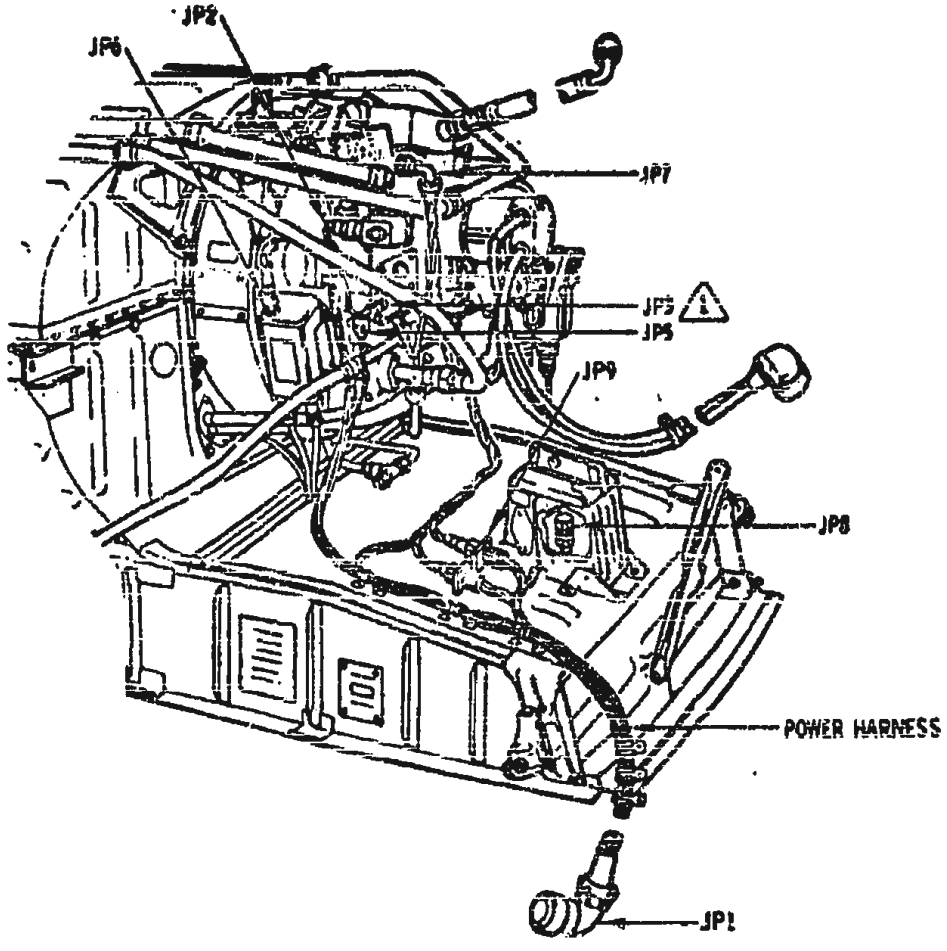
M1-0100-49-867

APU Signal Wiring Harness
Figure 13 (Sheet 1)



APU Signal Wiring Harness
Figure 13 (Sheet 2)

R EFFECTIVITY: ALL
R
0028



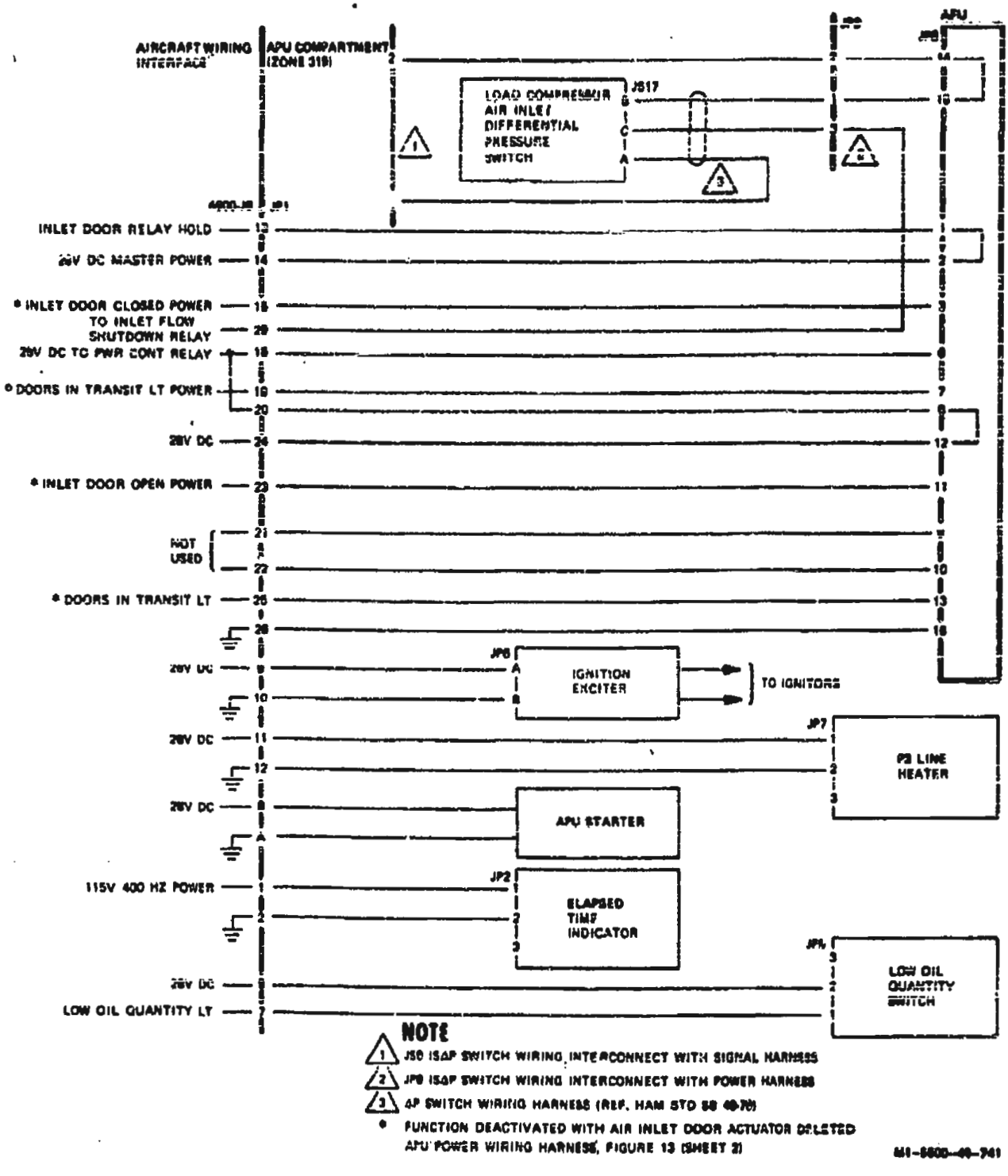
CONNECTOR DESIGNATION	POWER HARNESS CONNECTOR
JP1	FIREWALL CONNECTOR
JP2	ELAPSED TIME INDICATOR
JP3	CLOGGED FUEL FILTER 1
JP5	FLOAT SWITCH (LOW OIL QUANTITY)
JP6	IGNITION EXCITER
JP7	P3 LINE HEATER
JP8	ENGINE INLET DOOR ACTUATOR
JP9	ΔP HARNESS TO POWER HARNESS INTERCONNECT

NOTE

1 DELETED ON APU WITH HS SB 49-105

M1-0001-49-666

APU Power Wiring Harness
Figure 14 (Sheet 1)



NOTE

1. J50 ISAP SWITCH WIRING INTERCONNECT WITH SIGNAL HARNESS
2. JP8 ISAP SWITCH WIRING INTERCONNECT WITH POWER HARNESS
3. AP SWITCH WIRING HARNESS (REF. HAM STD 58 49-70)

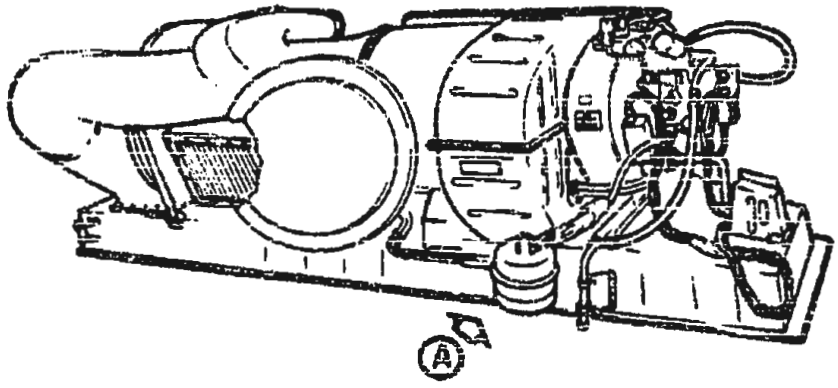
* FUNCTION DEACTIVATED WITH AIR INLET DOOR ACTUATOR DELETED APU POWER WIRING HARNESS, FIGURE 13 (SHEET 2)

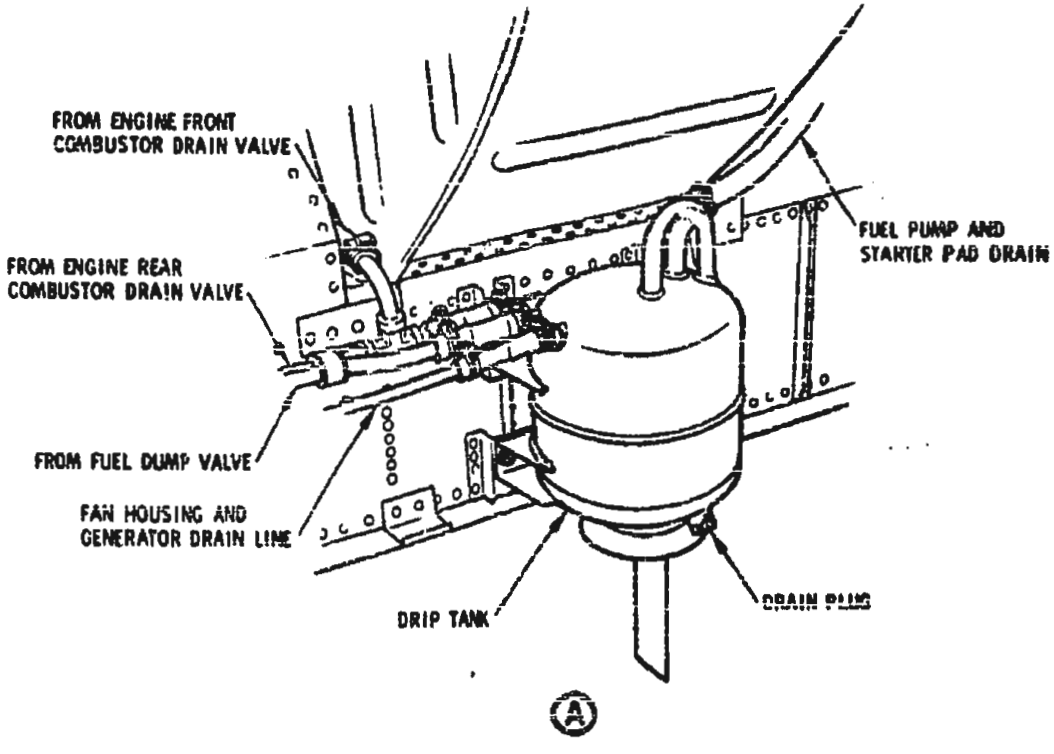
M1-5800-49-741

R R APU Power Wiring Harness
Figure 14 (Sheet 2)

R R EFFECTIVITY: ALL

002B




FROM ENGINE FRONT COMBUSTOR DRAIN VALVE
FROM ENGINE REAR COMBUSTOR DRAIN VALVE
FROM FUEL DUMP VALVE
FAN HOUSING AND GENERATOR DRAIN LINE
DRIP TANK
FUEL PUMP AND STARTER PAD DRAIN
A

M1-0102-49-022

APU Drip Tank
Figure 15

POWER PLANT SYSTEM - FAULT ISOLATION

R 1. General

Reference data and fault isolation procedures for troubleshooting APU powerplant system faults are included in this section of the manual. An APU system malfunction detected by the flight crew is normally entered in the aircraft flight log book and reported to maintenance personnel by a FIRM fault code number. This number and the flight log book write-up can be found in the Chapter 49 Fault Code Index. The index specifies the maintenance manual section, fault isolation diagram figure number and, where appropriate, a block number indicating the diagram entry point containing the fault isolation procedure. When no block number is specified, the diagram entry point is Block 1.

Prerequisites listed at the top of each diagram identify mandatory preliminary steps and circuit breakers that must be closed before initiating any fault isolation step.

Schematic diagrams, identified by a SCHEM number, supplement fault isolation procedures as maintenance aids. The schematics show the basic system circuitry necessary for troubleshooting and include cross-reference indexes to the wiring diagram manual pages required for checking component interconnect wiring.

C 1A. Reporting an APU Inoperative

C A. When an APU becomes inoperative and must be placarded, the C Maintenance Coordinators at MCI (MCIMD) must be advised.

C B. MCIMD, also, will want to know what is wrong with the APU. C A simple "INOP" is not acceptable. In order to get the APU C back into service as soon as possible, more specific C symptoms are needed. Small bits of information can save a C lot of guesswork and time.

C C. The following list is a guideline for things to look for. C These are general items and may not apply to all APU types.

C (1) Start problems

C Did inlet door operate?

C Did crank light come on?

C Did battery voltage drop/amperage draw indicate?

CR Was there fuel and/or ignition?

CR Was there any EGT indication?

CR Was there overspeed shutdown and at what speed?

CR EICAS message/BITE check on ECU?

CR What was RPM indication?

CR (2) Hung Start/Shutdowns

CR What was the EGT indication?

CR What was the RPM indication?

CR Did the crank light go out?

CR Did any flags show?

CR EICAS message/BITE check on ECU?

CR Was shutdown at engine start valve closure?

CR Was shutdown during aircraft or APU power changeover?

2. Supplemental data

Supplementary data includes functional tests, checkout tests, BITE checks and other general information that can be helpful in performing fault isolation. Supplementary data in this section is listed in Table 101.

R 2A. Electronic Controllers (ECU's) with HAM STD SB49-158

R Electronic Control Units (ECU's) incorporating HAM STD SB49-158
R have four 3 amp fuses mounted on the ECU front panel. The fuses
R protect ECU printed circuit boards and connectors from thermal
R damage caused by electrical shorts in aircraft wiring and
R components that interface with the ECU.

R F1 and F2 fuses are in the separate ECU controlled 28V CF
R (coarse filtered) dc power paths to the APU fuel bypass and fuel
R shutoff valve solenoids. If the F1 or F2 fuse is burned out, an
R APU start would be inhibited at 15-18% Ng. The fuel valve
R solenoids and 28V CF, power wiring between ECU and solenoid
R should be checked for a short to ground.

R A burned out F3 fuse would prevent 28V CF ECU input power from
R being applied to the ECU IGV light driver and sequencing circuit

R boards. The most likely cause would be a short in one of the
R ECU switched external loads (APU ignition or APU starter relay).
R Fault symptoms would be hangup and shutdown at 15-18% Ng or
R inoperative starter (no battery current or Ng indications).

R A burned out F4 fuse would remove 28V dc input power from the
R ECU internal power supply which develops the 28VF (filtered) dc
R power used in the inlet door malfunction switch, IGV controller
R torque motor, fuel controller torque motor, and air inlet flow
R shutdown relay circuits. It would also inhibit the +15/-15 V dc
R power supply generated voltages required by the ECU solid state
R fuel load control and sequencer circuitry. With the F4 fuse
R burned out, there would be no response to the APU start switch.
R Look for a shorted 28V dc power supply wire to one of the above
R components or a shorted controller torque motor.

Supplemental Data
Table 101

TABLE FIGURE NO.	TITLE
Table 102	APU Circuits Power OFF Continuity Check
Table 103	APU Circuits Power Application Check
Table 104	Fault Flag Versus Shutdown Mode (ECU P/N 724438-8)
Table 105	Fault Flag Versus Shutdown Mode (ECU P/N 724438-10 & later)

Table 102 includes data for use in checking APU component interconnect wiring. Table 102 provides expected resistance values as measured from the ECU support rack connectors with the ECU removed. Table 103 includes data for functionally checking APU power distribution circuitry and component response when electrical power is applied. Table 104 and 105 is a tabulation of shutdown modes vs fault flag indications.

Fault flags referred to as tripped, or not showing, relate only to the flag normally tripped by the initial shutdown failure mode. Other flags may appear as a result of the APU shutdown, or as multiple fault indicators, especially on aircraft having an ED724438-8 ECU without the multiple fault flag inhibit logic incorporated in -10, and later, ECU's. This can result in flight reports listing more than the flag showing and cause some confusion in selecting the correct fault isolation procedure

chart. Maintenance personnel must also consider that certain failure modes can result in entirely different fault symptoms during ground checkout attempts to reproduce the reported fault.

1. PREPARATION FOR APU POWER OFF CONTINUITY CHECK

(a) Verify that MASTER POWER switch on flight station APU CONTROL panel is set to OFF

(b) Remove ECU

NOTE: Resistance values in this table were obtained using a Simpson 260 meter having the meter polarity switch set in the position that connects the negative side of the meter battery to the red test lead terminal. If an equivalent meter is used, be certain it is internally set or wired to reflect the above test lead terminal polarity.

APU Circuits Power Off Continuity Check
Table 102

	FUNCTION	METER LEAD BLACK	METER LEAD RED	METER SCALE	RESULT
R	ECU Connector P1B (Outboard Bottom, Mates With Aircraft Harness Connector J6B)				
	IGV Feedback Transducer	10	20	X100	11.0 K (± 1 K) ohms
		12	20	X100	11.0 K (± 1 K) ohms
		12	13	X 1	Less than 1/2 ohm
		10	13	X100	without HS SB49-42 500 (± 100) ohms with HS SB49-42 2000 (± 500) ohms
		10	grd	X100	Infinity
		10	42	X100	Infinity
		grd	42	X 1	Less than 1/2 ohm
	Current Transformer	16	17	X 1	8 (± 2) ohms
		16	grd	X 1	Infinity

APU Circuits Power Off Continuity Check (Cont)
Table 102

FUNCTION	METER LEAD BLACK	RED	METER SCALE	RESULT
Inlet Door Malfunction Switch	18	39	X 1	Infinity (Inlet door closed)
	18	grd	X 1	Infinity
Load Compressor Controller (IGV Torque Motor)	19	29	X 1	36 (± 10) ohms
	19	grd	X100	Infinity
Free Turbine Speed Controller (Fuel Control Torque Motor)	21	grd	X100	Infinity
	21	30	X 1	62 (± 10) ohms
Fuel Bypass Solenoid	25	grd	X 1	30 (± 5) ohms
NfA Free Turbine Speed Sensor	26	31	X 1	55 (± 45) ohms (P/N 738703-2) or (P/N 738703-3)
	26	31	X100	1700 (± 300) ohms (P/N 738703-1)
	26	grd	X100	Infinity
	shld	gnd	X 1	Less than 2 ohms
Inlet Temp Sensor	27	28	X100	8.5 (±0.5)K ohms at 75 (±5.0)F
	27	grd	X100	Infinity
Low Oil Press Switch	34	35	X 1	Infinity
	34	grd	X100	Infinity

APU Circuits Power Off Continuity Check (Cont)
Table 102

FUNCTION	METER BLACK LEAD	METER RED LEAD	METER SCALE	RESULT
	35	gnd	X100	Infinity
High Oil Temp Switch	45	44	X 1	Infinity
	44	grd	X100	Infinity
Gas Generator Tachometer (Ng)	32	grd	X100	Infinity
	32	37	X100	420 (± 100) ohms
NfB Free Turbine Sensor	40	grd	X100	Infinity
	40	41	X 1	55 (± 45) ohms (P/N 738703-2) or (P/N 738703-3)
	40	41	X100	1700 (± 300) ohms (P/N 738703-1)
	shld	gnd	X 1	Less than 2 ohms
Fuel Shutoff Solenoid	38	grd	X 1	30 (± 5) ohms
R ECU Connector P1A (Outboard-top, Mates With Aircraft Harness Connector J6A)				
Don't Load	2	grd	X 1	200 (± 50) ohms
Start/Stop	5	grd	X100	Infinity
	5	18	X100	Infinity
	8	18	X 1	Less than 1/2 ohm
	18	grd	X100	Infinity
GCU (Electrical load signal)	9	28	X100	6000 or more ohms

APU Circuits Power Off Continuity Check (Cont)
Table 102

FUNCTION	METER BLACK	LEAD RED	METER SCALE	RESULT
	9	grd	X100	6000 or more ohms
	28	grd	X 1	Less than 1/2 ohm
TGT Indicator	20	30	X100	200 (± 50) ohms
	20	grd	X100	Infinity
Percent Ng RPM Indication	44	45	X 1	Infinity
	44	grd	X100	Infinity
Inlet Door Grd	26	grd	X100	Infinity
Ignition Control	4	grd	X100	260 (± 50) ohms
Mode Select (Norm)	23	grd	X100	Infinity
	23	43	X100	Infinity
Mode Select (Min)	24	grd	X100	Infinity
	24	43	X100	Less than 1/2 ohm
Mode Select (Max)	14	grd	X100	Infinity
	14	43	X100	Infinity
Mode Select (Common)	43	grd	X100	Infinity
Shield Grd	42	grd	X 1	Less than 1/2 ohm
Starter Relay	37	grd	X 1	60 (± 10) ohms
R Connector P2A (Inboard-top, Mates With Aircraft Harness Connector J5A)				
Shield Grd	2	grd	X 1	Less than 1/2 ohm
TGT	1	7	X 1	20 (± 5) ohms
	1	grd	X100	Infinity
	7	grd	X100	Infinity

APU Circuits Power Off Continuity Check (Cont)
Table 102

FUNCTION	METER LEAD BLACK	RED	METER SCALE	RESULT
Ground	5	grd	X 1	Less than 1/2 ohm
Continuous Power (28V dc)	6	grd	X100	Infinity
	6	25	X 1	Less than 1/2 ohm
Ground	8	grd	X 1	Less than 1/2 ohm
Ground	14	grd	X 1	Less than 1/2 ohm
Ground	20	grd	X 1	Less than 1/2 ohm

APU Circuits Power Application Check
Table 103

ACTION	RESULT
1. Preparation	
(a) Turn on electrical power (24-41-00).	
(b) Remove ECU from rack.	
(c) Jumper ECU rack connector J6A pin 26 to ground.	
2. On the FE/SO APU CONTROL panel, place the MASTER POWER switch to "ON", then release switch	A. Switch solenoid must hold switch on
	B. EMERGENCY SHUTOFF PRI light (APU primary fuel shutoff valve) must illuminate briefly as valve opens
	C. AUTOFIRE SHUTDOWN ARMED light must come on
3. Disconnect APU low oil level switch connector (JP5) and jumper pins 1 to 2 of connector	A. LOW OIL QUANTITY light must come on
4. Remove jumper and reinstall JP5 connector	A. LOW OIL QUANTITY light must go off
5. Disconnect APU oil temperature switch connector (JS5) and jumper pins 1 to 2	A. Check ECU rack connector J6B pins 44 to 45 for less than 1/2 ohm resistance
6. Remove jumper and reinstall JS5 connector	A. Resistance from pin 44 to 45 of J6B must increase to infinity
7. Press START button and hold for 2 seconds, then release	A. DOOR IN TRANSIT light must come on for approximately 10 seconds, then go off
R	B. Ejector doors must be open

APU Circuits Power Application Check (Cont)
Table 103

	ACTION		RESULT
		C.	Gen adapter PRESS light must come on when DOOR IN TRANSIT light goes off
8.	Test for nominal 28 Vdc voltage to ground at controller rack connector J5A pins 6 and 25	A.	Voltage must be present at both pins
9.	Press and hold START switch while checking ECU connector J6A pins 5 to 18 for continuity and 8 to 18 for open	A.	Resistance must be less than 1/2 ohm from pin 5 to 18
		B.	Resistance must read infinity on highest scale of ohmmeter from pin 8 to 18
10.	Press and hold STOP button while checking ECU connector J6A pins 8 to 18 for continuity and 5 to 18 for open	A.	Resistance must be less than 1/2 ohm from pins 8 to 18
		B.	Resistance must read infinity on highest scale of ohmmeter from pin 5 to 18
11.	Jumper ECU connector J6A pin 10 to ground	A.	LOW PRESS OIL fault flag must trip (flag visible)
12.	Remove jumper and press fault flag RESET	A.	LOW PRESS OIL flag must retract
13.	Jumper ECU connector J6A pin 16 to ground	A.	OVERTEMP TGT flag must trip (flag visible)
14.	Remove jumper and press fault flag RESET	A.	OVERTEMP TGT flag must retract
15.	Jumper ECU connector J6A pin 38 to ground	A.	OVERSPEED N2 flag must trip (flag visible).
16.	Remove jumper and press fault flag RESET	A.	OVERSPEED N2 flag must retract

APU Circuits Power Application Check (Cont)
Table 103

	ACTION		RESULT
17.	Jumper ECU connector J6A pin 39 to ground	A.	HIGH TEMP OIL flag must trip (flag visible)
18.	Remove jumper and press fault flag RESET	A.	HIGH TEMP OIL flag must retract
19.	Press FE/SO panel light test switch	A.	All APU flags must drop
		B.	ECU connector J6A pins 10, 16, 38 and 39 must show no continuity to ground with ohmmeter positive battery lead on each pin
	NOTE: Most ohmmeters are made with black test lead giving + polarity of internal battery. Check your meter to be sure it conforms as this is a check of circuit blocking diodes.		
20.	Release light test switch and press flag RESET switch.	A.	All flags must reset
21.	Check continuity between ECU rack connector J6B pins 18 and 39	A.	Resistance must be 1/2 ohm or less (air inlet door open).
22.	Disconnect JP6 connector at top of ignition exciter and prepare to measure voltage across pins A and B of connector		
23.	Jumper ECU connector J5A pin 25 to J6A pin 4	A.	Ignition relay must actuate and apply 28VDC to pins A & B of JP6 connector
24.	Remove jumpers but leave connector disconnected for later tests		
25.	Momentarily (for 2 or 3 seconds) jumper ECU connector J5A pin 25 to J6A pin 37	A.	Starter relay must actuate and APU will begin to crank

APU Circuits Power Application Check (Cont)
Table 103

	ACTION		RESULT
	NOTE: Do not crank APU for more than a few (2 or 3) seconds.		
26.	Depress and latch BLEED AIR S/O switchlight.	A.	Initial temperature of APU bleed air S/O valve solenoid must feel cool to touch
27.	Rotate compressor mode select switch to MIN MODE.	A.	Check for less than 1/2 ohm resistance between ECU connector J6A pins 24 and 43
28.	Rotate mode select switch to NORM.	A.	ECU connector J6A pins 24 to 43 must show no continuity and pins 23 to 43 must show less than 1/2 ohm resistance
29.	Hold compressor mode select switch in MAX MODE.	A.	MAX MODE light must come on
		B.	ECU connector J6A pins 23 to 43 must show no continuity and pins 14 to 43 must show less than 1/2 ohm resistance
30.	Feel bleed air shutoff valve solenoid	A.	Solenoid must feel warm to touch
31.	Depress and unlatch BLEED AIR S/O switchlight	A.	ECU connector J6A pins 14 to 43 must lose continuity and pins 24 to 43 must again show less than 1/2 ohm resistance
32.	Remove jumper from ECU connector J6A pin 26 to ground	A.	DOOR IN TRANSIT light must come on for approximately 10 seconds, then go off
		B.	GEN OIL PRESS light must remain on
		C.	APU vent air ejector doors must close
		D.	Bleed air shutoff valve solenoid must cool

APU Circuits Power Application Check (Cont)
Table 103

ACTION	RESULT
NOTE: Leave MASTER POWER switch on long enough to verify bleed air shutoff valve solenoid is cooling.	
33. Place MASTER POWER switch to OFF position.	
34. Reinstall ECU	
35. Reconnect APU connectors removed for tests	

Fault/Fault Flag Versus Shutdown Modes (ED724438-8 ECU's)
Table 104

	SHUTDOWN MODE	APU CONTROL PANEL INDICATION	POSSIBLE COASTDOWN FLAGS	DOOR IN TRANSIT LIGHT
1.	Loss of NfA	OVERSPEED N2	None	Yes
2.	Nf Overspeed	OVERSPEED N2	LOW PRESS OIL	Yes
3.	Low Oil Pressure[4]	LOW PRESS OIL	OVERSPEED N2[1]	Yes
4.	High Turbine Temp	OVERTEMP TGT	LOW PRESS OIL[3] followed by OVERSPEED N2[1]	Yes
5.	High Oil Temp	HIGH TEMP OIL	OVERSPEED N2[1], possibly LOW PRESS OIL	Yes
6.	Complete Loss of Ng	None	None if below 55%, LOW PRESS OIL and OVERSPEED N2, if above 55%	Yes
7.	Partial Loss of Ng	OVERSPEED N2	2 and 3 Above	Yes
8.	Fail to Start	None	None	No
9.	Power Interrupt	None	2 and 3 Above	Yes
10.	High Inlet Pressure Differential[2]	(Inlet Flow Light)	None	Yes
11.	Door Malfunction[2]	None	None	Yes
12.	Normal Stop	None	None	Yes
13.	Fire Stop	None	None	Yes
14.	Fuel Starvation	None	LOW PRESS OIL[3] followed by OVERSPEED N2[1]	Yes

Fault/Fault Flag Versus Shutdown Modes (ED724438-8 ECU's) (Cont)
Table 104

SHUTDOWN MODE	APU CONTROL PANEL INDICATION	POSSIBLE COASTDOWN FLAGS	DOOR IN TRANSIT LIGHT

[1] Loss of NfA signal on coastdown.
[2] Inhibited in MAX MODE.
[3] If free turbine coastdown time is very rapid, LOW PRESS OIL flag will not set.
[4] LOW PRESS OIL flag is inhibited by the presence of any other fault condition; however, if the initial condition clears during shutdown, the LOW PRESS OIL flag will probably set.

Fault/Fault Flag Versus Shutdown Modes (ED724438-10 and -11 ECU's)
Table 105

	SHUTDOWN MODE	APU CONTROL PANEL INDICATION	POSSIBLE COASTDOWN FLAGS[4]	DOOR IN TRANSIT LIGHT
1.	Loss of NfA	OVERSPEED N2	None	Yes
2.	Nf Overspeed	OVERSPEED N2	None	Yes
3.	Low Oil Pressure	LOW PRESS OIL	None	Yes
4.	High Turbine Temp	OVERTEMP TGT	None	Yes[3]
5.	High Oil Temp	HIGH TEMP OIL	None	Yes[3]
6.	Complete Loss of Ng	None	[1]	Yes[3]
7.	Partial Loss of Ng	None	[1]	Yes
8.	Fail to Start	None	None	No
9.	Power Interrupt	None	[1]	Yes[3]
10.	High Inlet Pressure Differential[2]	(Inlet Flow Light)	None	Yes
11.	Door Malfunction[2]	None	None	Yes
12.	Normal Stop	None	None	Yes
13.	Fire Stop	None	None	Yes
14.	Fuel Starvation	None	[1]	Yes[3]

Fault/Fault Flag Versus Shutdown Modes (ED724438-10 and -11 ECU's)
(Cont)
Table 105

SHUTDOWN MODE	APU CONTROL PANEL INDICATION	POSSIBLE COASTDOWN FLAGS[1]	DOOR IN TRANSIT LIGHT

[1] Varies with actual Ng level at time of signal loss, and with free turbine coastdown time. If Ng is above approximately 80% (for -10) or 70% (for -11) and signal suddenly drops below 70% (for -10) or 60% (for -11) level, OVERTEMP TGT flag will set. At low Ng levels above 55%, OVERSPEED N2 flag will set if free turbine coastdown is relatively short, or LOW PRESS OIL flag will set if coastdown time is longer.

[2] Inhibited in MAX MODE.

[3] If Ng had been greater than 55%.

[4] Since a comparatively long time is necessary to assure that the FE/SO APU CONTROL Panel Fault Indicator is set and latched, the initiating fault condition is allowed to persist for approximately one-half second before the multiple fault flag inhibit logic washes out the primary fault and inhibits the others. If more than one fault condition occurs in this time period, multiple flags will occur. Also, for ECU's not incorporating L10, multiple flags are not inhibited if +28V dc controller input power is below 25V dc.

3. Fault Isolation

Table 106 is a list of fault isolation data in this section of the manual.

APU Fault Symptoms
Table 106

	FIGURE	DESCRIPTION
	103	AUTOFIRE SHUTDOWN ARMED light does not come on when APU MASTER POWER switch is latched
	104	APU does not start, No DOOR IN TRANSIT light; DONT LOAD light not on
R	105	DELETED
	106	DOOR IN TRANSIT light remains on, APU starts and runs
	107	DONT LOAD light does not come on, APU starts and runs
	108	APU does not start. DOOR IN TRANSIT light On, Then off; DONT LOAD light does not come on
	109	APU does not start. No starter battery current; DONT LOAD light on
	110	APU does not light off, hangs at 15 to 18% Ng, then shuts down
	111	APU does not run; lights off, but hangs below 55% Ng
	112	EMERGENCY SHUTOFF PRI light remains on when APU MASTER POWER switch is latched
	113	No Ng indication during start, Starter Battery Current OK
	114	Low MAX MODE load compressor output
	115	OVERSPEED N2 Trip
	116	APU shuts down with LOW PRESS OIL flag tripped
	117	APU shuts down with HIGH TEMP OIL flag tripped
	118	APU Auto shutdown. No fault flag.
	119	APU MASTER POWER switch does not latch ON

APU Fault Symptoms (Cont)
Table 106

	FIGURE	DESCRIPTION
	120	APU will not go into MAX MODE; OK in NORM MODE
	121	LOW OIL QUANTITY light comes on
	122	BLEED AIR S/O OPEN light does not come on
	123	BLEED AIR S/O OPEN light on with switch out
R	124	APU does not go into NORM Mode
	125	AUTOFIRE SHUTDOWN ARMED and GEN OIL PRESS lights remain on when MASTER POWER is switched off
R	126	APU operates in NORM mode, with MIN mode selected
	127	APU operates in MAX MODE at all times
	128	APU hangs up, or accelerates erratically between 60% and 90% Ng
	129	APU cranks but does not light off, EMERGENCY SHUTOFF SEC light is on
	130	APU operating parameters (Ng, TGT, duct pressure, gen. freq.) fluctuate
	131	TGT Fault
	132	APU ejector doors close when start switch is released
	133	APU does not shut down when STOP switch is depressed
	134	DOOR IN TRANSIT light does not indicate closure of VENT AIR Ejector doors
	135	Autofire shutdown
	136	APU shuts down when APU generator comes on the line
	137	APU generator does not come on line; DONT LOAD light on

COMPONENT	QTY	AREA/ACCESS	REFERENCE
AIR INLET DOOR	1	APU PLATFORM – BOTTOM	49–11–05
ACTUATOR – VENT EJECTOR	1	ON APU/319BR, DR	49–11–19
CIRCUIT BREAKERS:			
APU BLEED AIR VALVE	1	FLT STA/CB3 B10	•
CONT POWER	1	FLT STA/CB3 B12	•
EJECTOR AND VENT VALVE	1	FLT STA/CB3 B15	•
FIRE DET LOOP "A" ALARM	1	FLT STA/CB1 D16	•
FIRE DET LOOP "B" ALARM	1	FLT STA/CB1 D17	•
FIRE DET MASTER ALARM POWER	1	FLT STA/CB1 D18	•
FIRE EXT APU MAIN	1	FLT STA/CB1 C16	•
FIRE EXT APU ALTN	1	FLT STA/CB1 C17	•
FIRE EXT APU FIRE SHUTDOWN	1	FLT STA/CB1 C18	•
FIRE HORN	1	FLT STA/CB3 B6	•
FIREWALL SHUTOFF PRI	1	FLT STA/CB3 B7	•
FIREWALL SHUTOFF SEC	1	FLT STA/CB3 B8	•
IGNITION	1	FLT STA/CB3 B11	•
BAT POWER	1	FLT STA/CB3 B10	•
T/R POWER	1	FLT STA/CB3 B11	•
POWER CONTROL	1	FLT STA/CB3 B13	•
CONTROLLER – BUS 2	1	FLT STA/CB3 B13	•
CONTROLLER – GND BUS	1	FLT STA/CB3 B14	•
CONTROL AND PRI F/W SOV GND BUS	1	FLT STA/CB3 B15	•
CONTROL AND PRI F/W SOV BUS 2	1	FLT STA/CB3 B16	•
GEN CONT UNIT	1	FLT STA/CB3 B17	•
CONTROLLER:			
ELECTRONIC (ECU)	1	AEEA/162BR	49–00–02
FREE TURBINE SPEED	1	ON APU/319BR	49–31–05
LOAD COMPRESSOR (IGV)	1	ON APU/319BR	49–51–03
SURGE VALVE	1	ON APU/319DL	49–51–10
CURRENT LIMITER – 225A (4041-FI)	1	MESC/137MZ, 131AR	•
ENGINE DRIVEN FUEL PUMP	1	ON APU/319AL	49–31–01
ENGINE TACHOMETER	1	ON APU/316BR	49–75–01
ENGINE TEMP HARNESS	1	ON APU/319DR	49–71–02
EQUIP AND POWER CONTROL PANEL	1	AEEA/162BR	49–00–00

*SEE WM EQUIPMENT LIST

M1–0000–49–1061

R
R

Component Locator Index
Figure 101 (Sheet 1)

EFFECTIVITY: ALL

002B

COMPONENT	QTY	AREA/ACCESS	REFERENCE
FILTERS:			
FUEL	1	ON APU/319AL	49-31-07
ELEMENT, ENG BLEED AIR VALVE	1	ON APU/319AL, CL	49-21-08
ELEMENT, IGV P3 AIR, FCU		ON APU/319AL, CL	49-51-20
SURGE CONTROL, ADJUSTABLE ORIFICE	1	ON APU/319AL, CL	49-01-27
OIL FILTER	1	ON APU/319AL	49-21-04
FUEL CONTROL UNIT (FCU)	1	ON APU/319AL	49-31-02
FUEL NOZZLES	14	ON APU/319AL, BR	49-31-12
HEAT EXCHANGER:			
OIL/AIR	1	ON APU/319BR	49-61-01
OIL/FUEL	1	ON APU/319AL, BR	49-31-10
IGNITION-EXCITER	1	ON APU/319BR	49-41-07
IGNITER PLUG	1	ON APU/319BR	49-41-01
IGV FEEDBACK TRANSDUCER	1	ON APU/319CL	49-51-07
INDICATOR:			
ELAPSED TIME	1	ON APU/319BR	49-61-01
NG, GAS GENERATOR	1	FE/SO PNL	49-73-02
TGT, TURBINE GAS TEMP	1	FE/SO PNL	49-71-02
Ng TRIM ADJUSTMENT	1	AEEA/1628R	49-00-02
PANEL, CONTROL	1	FE/SO PNL	49-00-06
SENSOR:			
AIR INLET TEMP (T12)	1	ON APU/319BR	49-31-03
FREE TURBINE SPEED – BOTTOM	1	ON APU/319CL	49-31-06
FREE TURBINE SPEED – TOP	1	ON APU/319CL	49-31-04
STARTER	1	ON APU/319BR	49-41-04
SWITCH:			
APU MASTER POWER	1	FE/SO PNL	*
APU MODE SELECT (4961-S10)	1	FE/SO PNL	*
START (4961-DS2)	1	FE/SO PNL	*
STOP	1	FE/SO PNL	*
DIFF PRES, AIR INLET FLOW	1	ON APU/319AL, CL	49-51-21
HIGH OIL TEMP	1	ON APU/319AL	49-91-02
LIGHT, BLEED AIR SOV	1	FE/SO PNL	*
LOW OIL PRESSURE	1	ON APU/319AL	49-91-03
LOW OIL QUANTITY	1	ON APU/319BR	49-91-04

*SEE WM EQUIPMENT LIST

M1-0001-49-814

Component Locator Index
Figure 101 (Sheet 2)

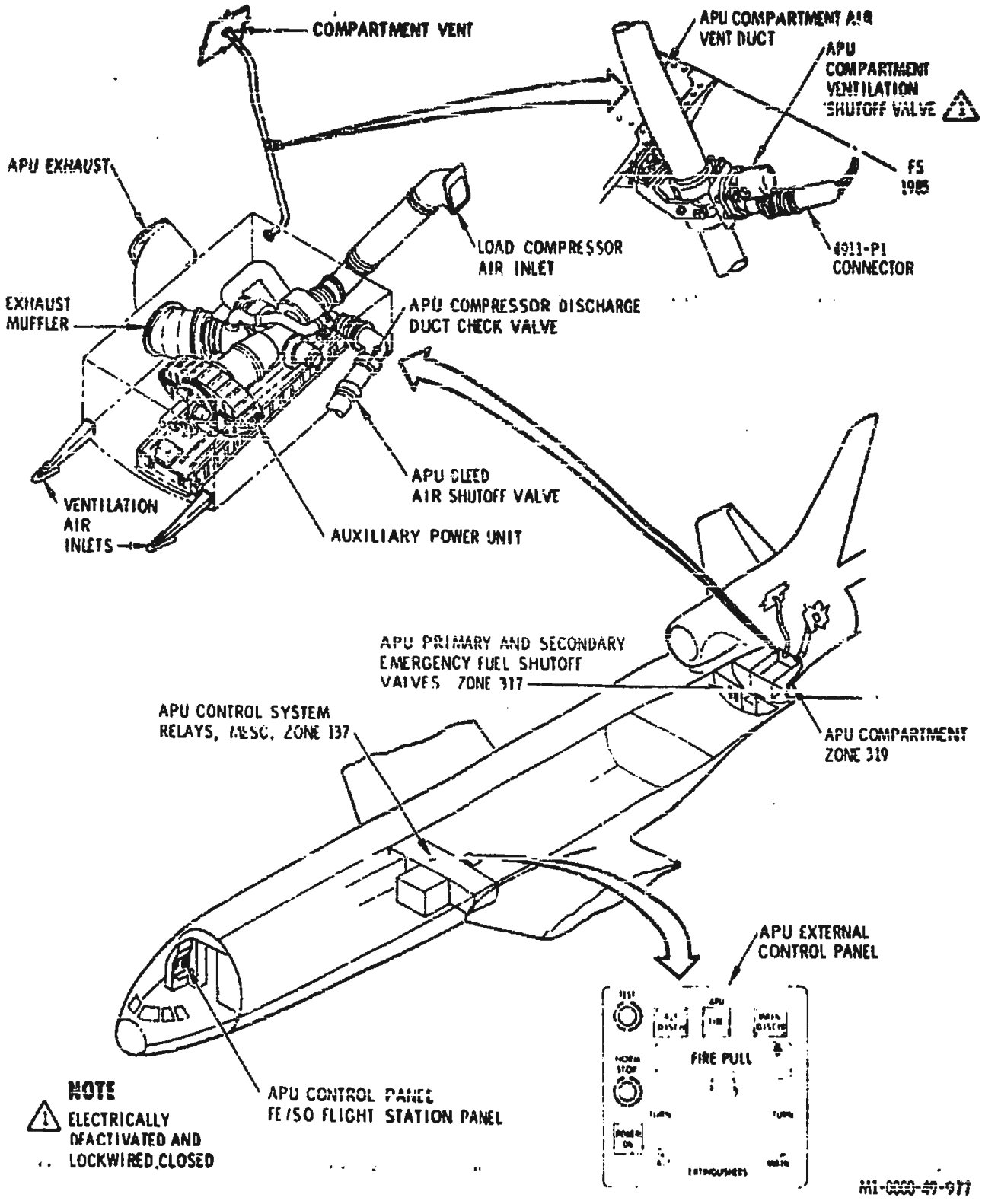
R EFFECTIVITY: ALL
R
002B

COMPONENT	QTY	AREA/ACCESS	REFERENCE
VALVES			
AUTO FUEL SHUTOFF	1	ON APU/319AL	49-31-11
BLEED AIR SOV	1	ON APU/317DL	36-12-02
CHECK, LOAD COMP. DISCH	1	ON APU/317DL	49-31-16
ENGINE BLEED ORIFICES	1	ON APU/319AL, CL	49-21-09
FIREWALL FUEL SHUTOFF	1	APU COMPT/317BB	49-31-15
FLOW DIVIDER AND DUMP	1	ON APU/319AL	49-31-17
SEC EMERGENCY FUEL SOV	1	APU COMPT/317BB	49-31-15
VOLTAGE REGULATOR (4861-VR1)	1	ASEA/162BR	*

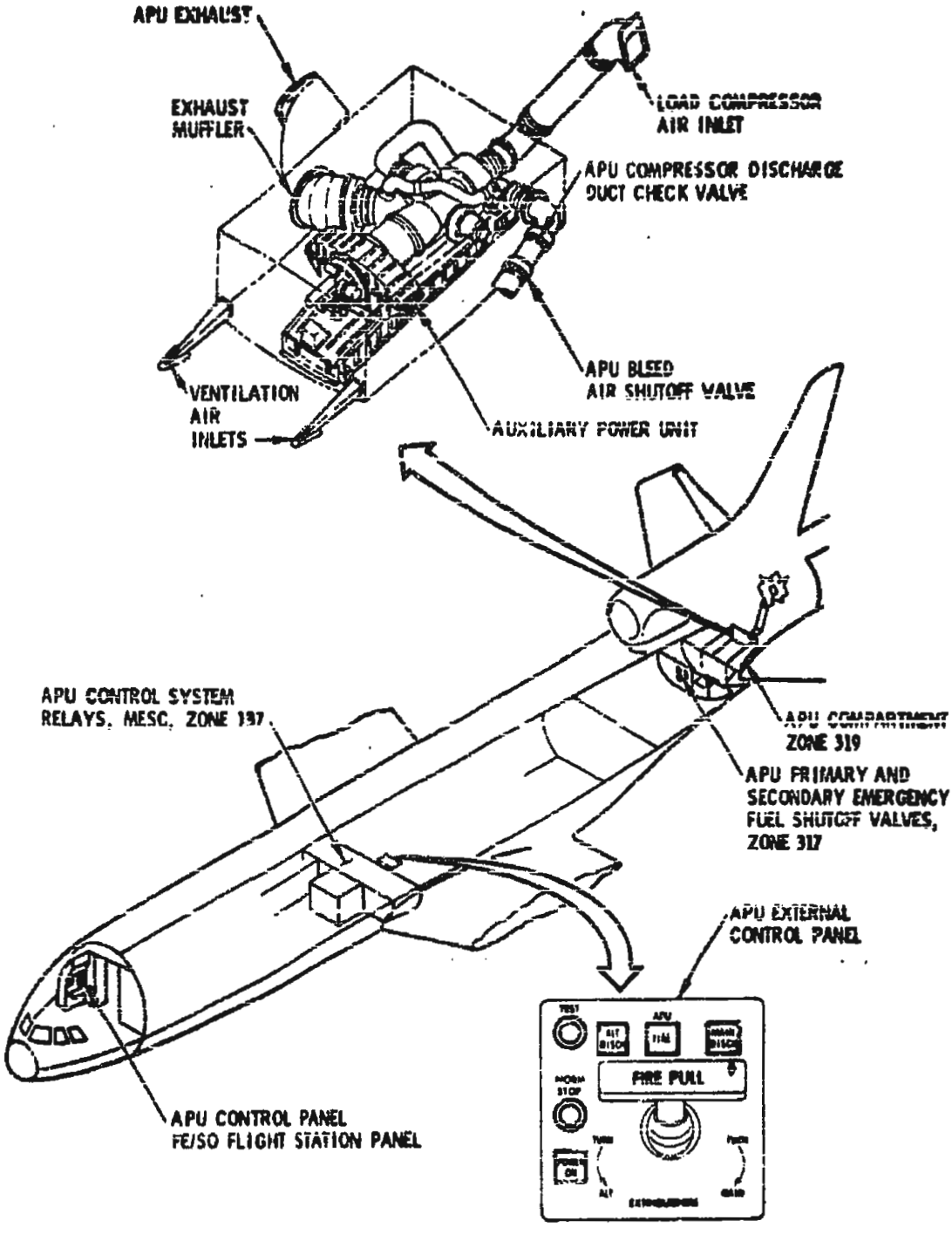
*SEE WM EQUIPMENT LIST

M1-0000-49-81A

Component Locator Index
Figure 101 (Sheet 3)

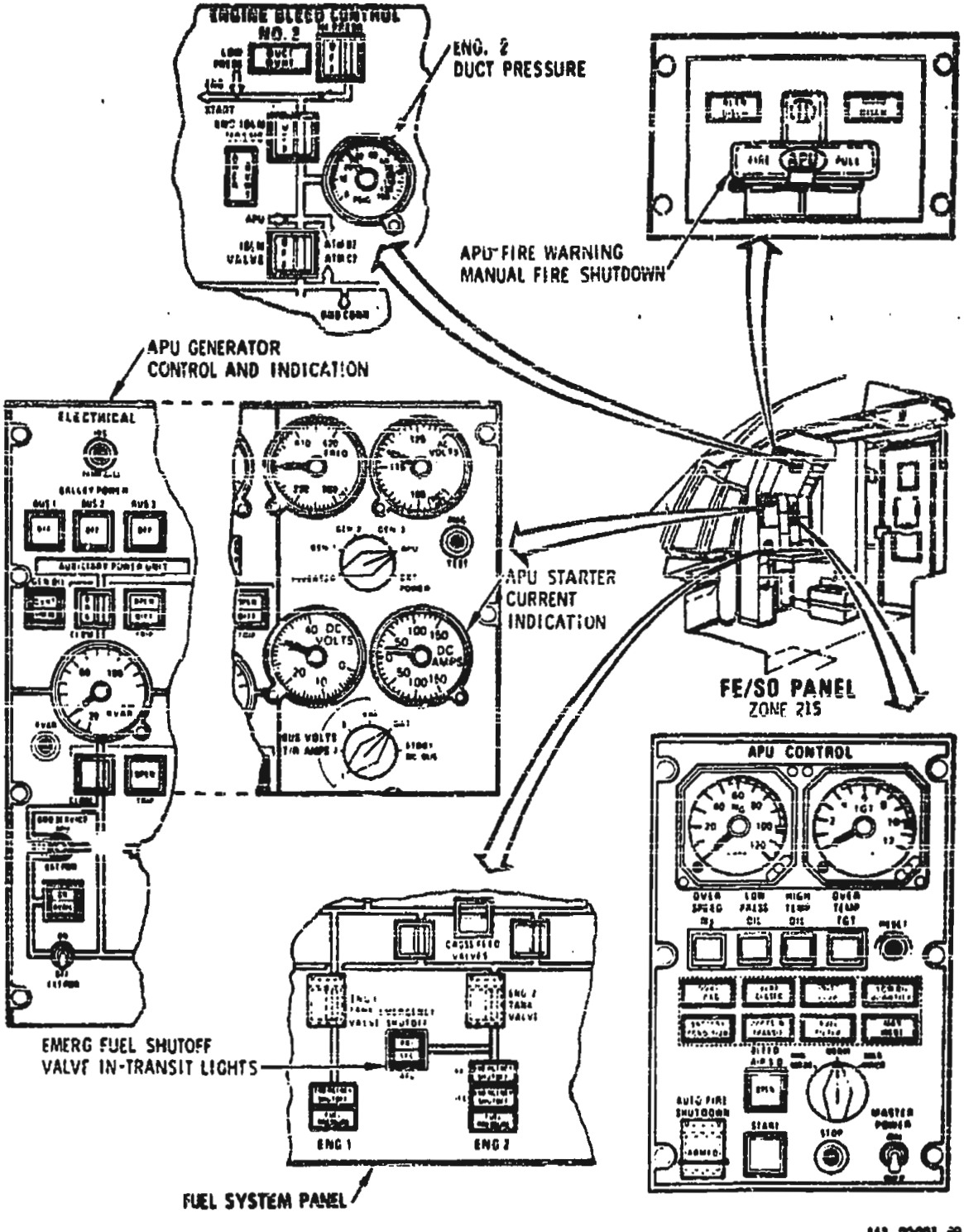

COMPARTMENT VENT
APU COMPARTMENT AIR VENT DUCT
APU COMPARTMENT VENTILATION SHUTOFF VALVE
APU EXHAUST
FS 1985
LOAD COMPRESSOR AIR INLET
4911-P1 CONNECTOR
EXHAUST MUFFLER
APU COMPRESSOR DISCHARGE DUCT CHECK VALVE
APU BLEED AIR SHUTOFF VALVE
VENTILATION AIR INLETS
AUXILIARY POWER UNIT
APU PRIMARY AND SECONDARY EMERGENCY FUEL SHUTOFF VALVES ZONE 317
APU CONTROL SYSTEM RELAYS, MISC. ZONE 137
APU COMPARTMENT ZONE 319
APU EXTERNAL CONTROL PANEL
FIRE PULL
APU CONTROL PANEL P5/S0 FLIGHT STATION PANEL
NOTE
1 ELECTRICALLY DEACTIVATED AND LOCKWIRED CLOSED
M1-0000-49-977

APU Components Locator
Figure 102 (Sheet 1)


APU EXHAUST
EXHAUST MUFFLER
LOAD COMPRESSOR AIR INLET
APU COMPRESSOR DISCHARGE DUCT CHECK VALVE
APU BLEED AIR SHUTOFF VALVE
VENTILATION AIR INLETS
AUXILIARY POWER UNIT
APU CONTROL SYSTEM RELAYS, MESC, ZONE 197
ZONE 319
APU PRIMARY AND SECONDARY EMERGENCY FUEL SHUTOFF VALVES, ZONE 317
APU EXTERNAL CONTROL PANEL
FIRE PULL
APU CONTROL PANEL
FE/SO FLIGHT STATION PANEL

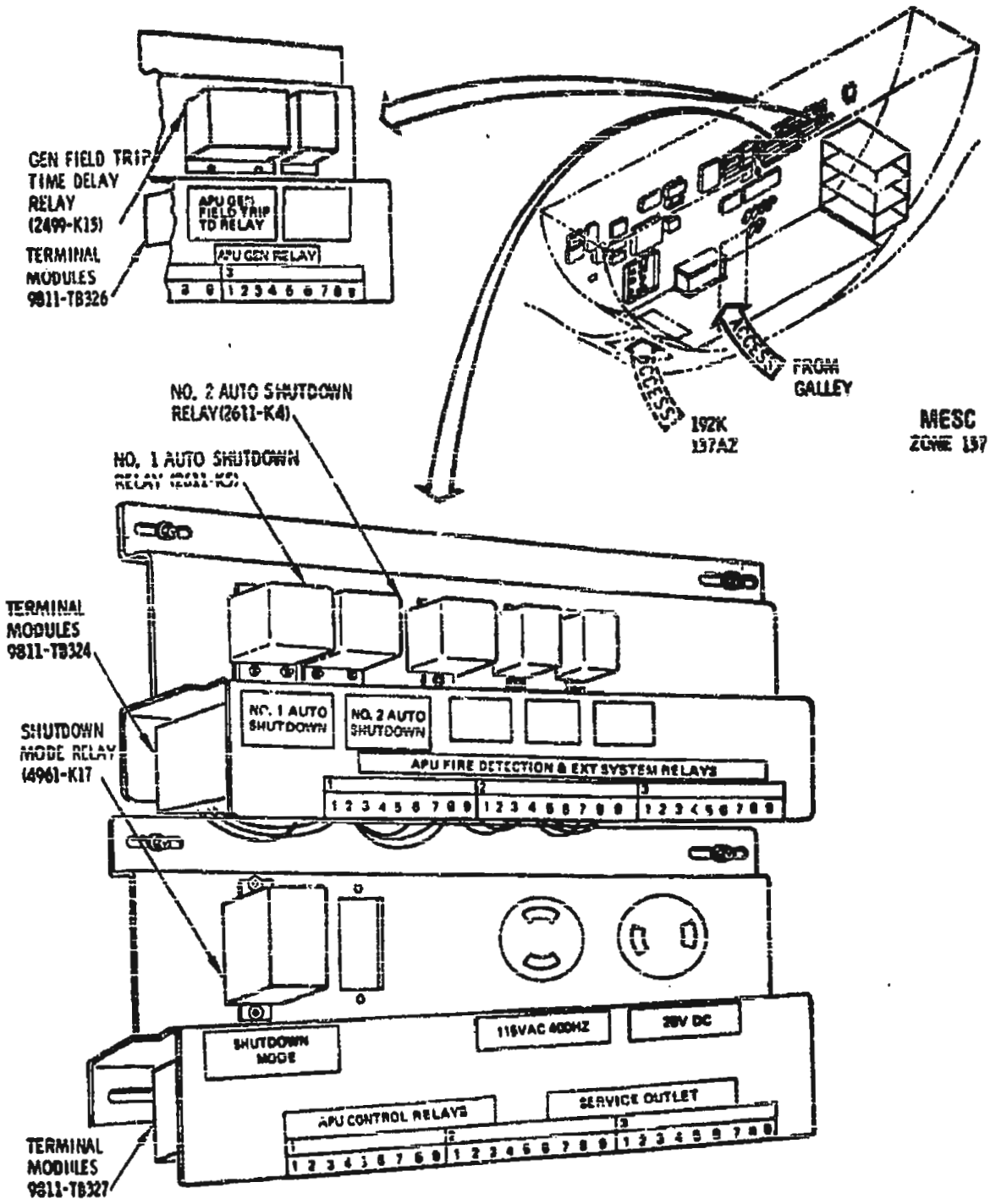
M1-0000-49-025

APU Components Locator
Figure 102 (Sheet 1)

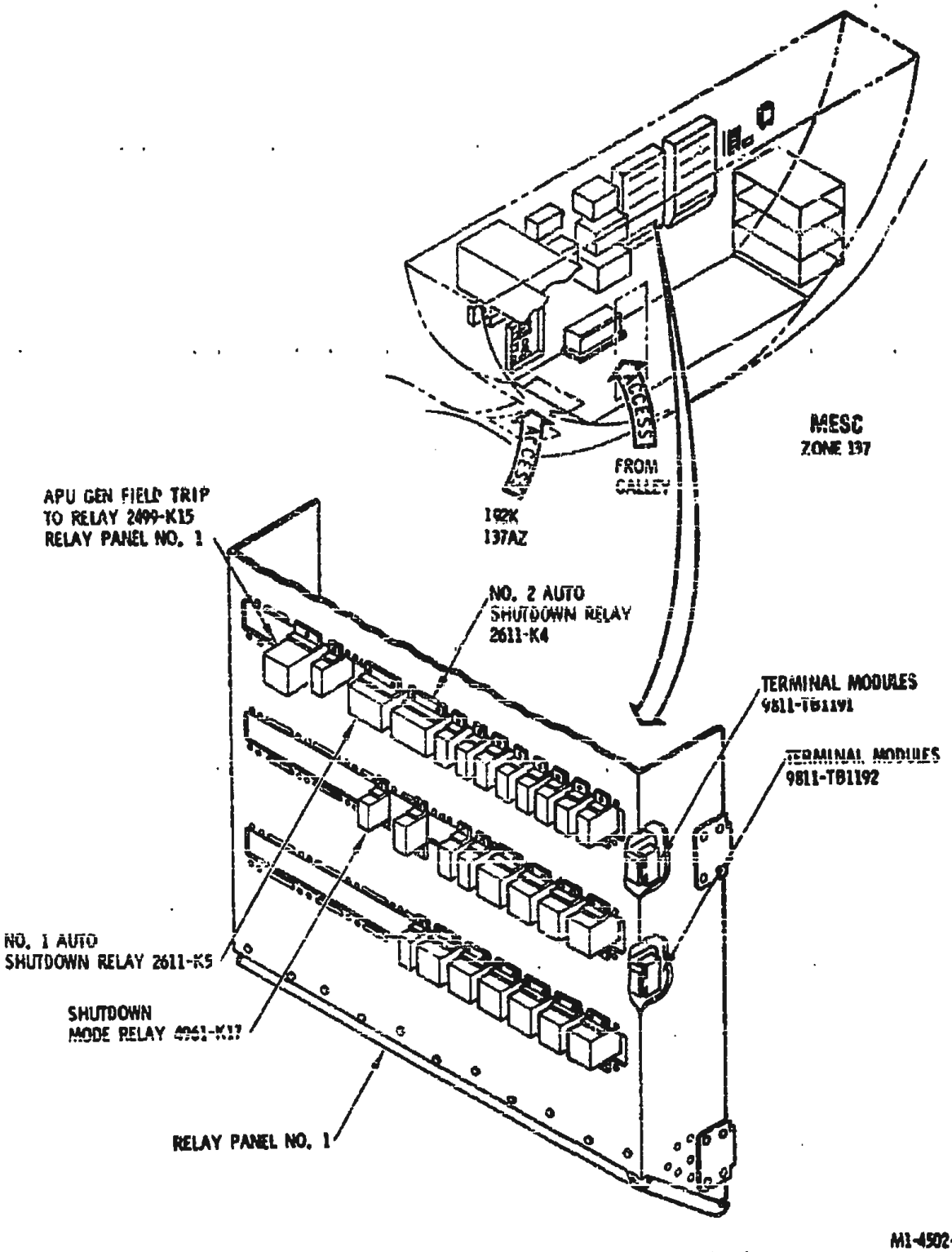


M1-23001-49-599

APU Components Locator
Figure 102 (Sheet 2)

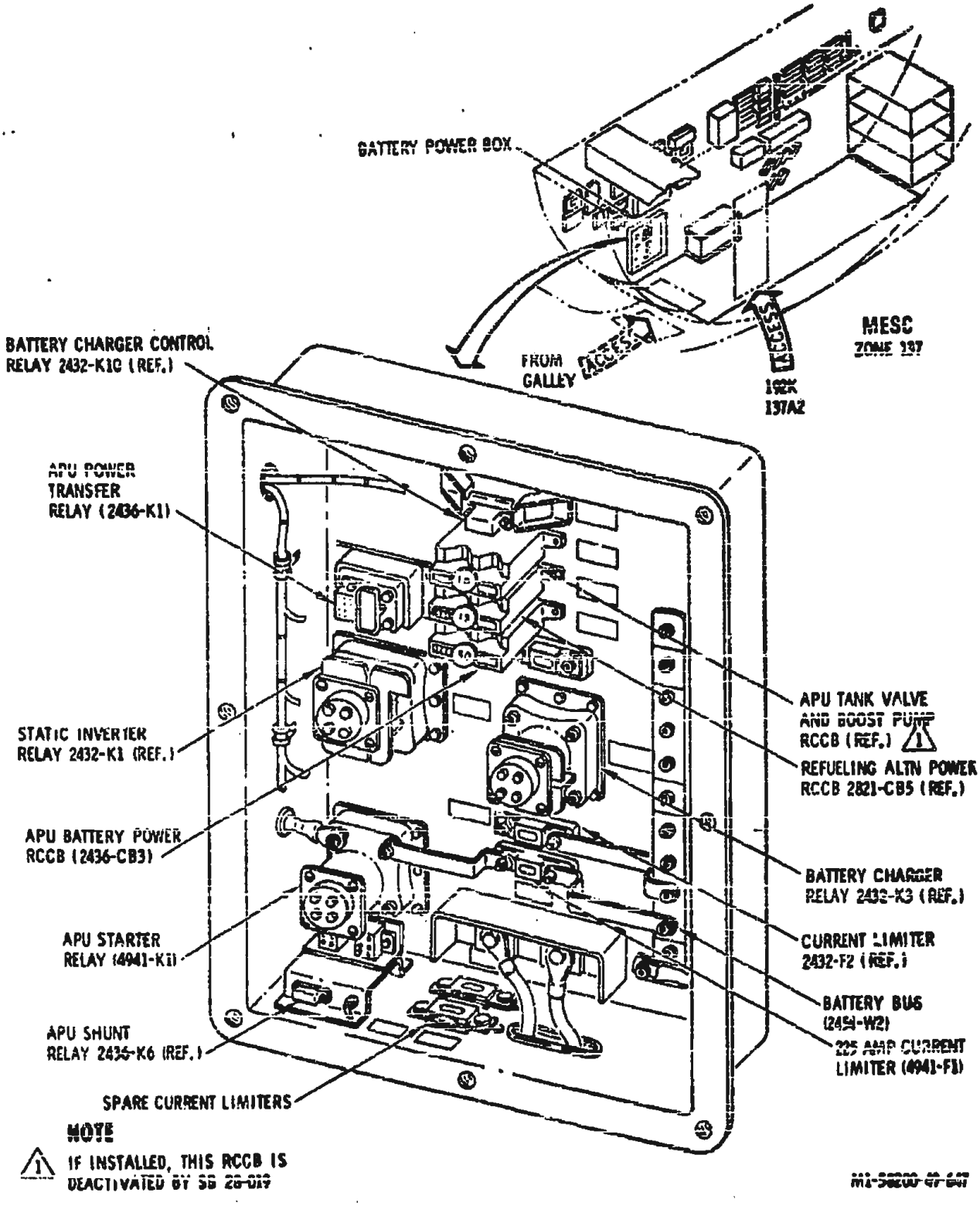


APU Components Locator
Figure 102 (Sheet 3)

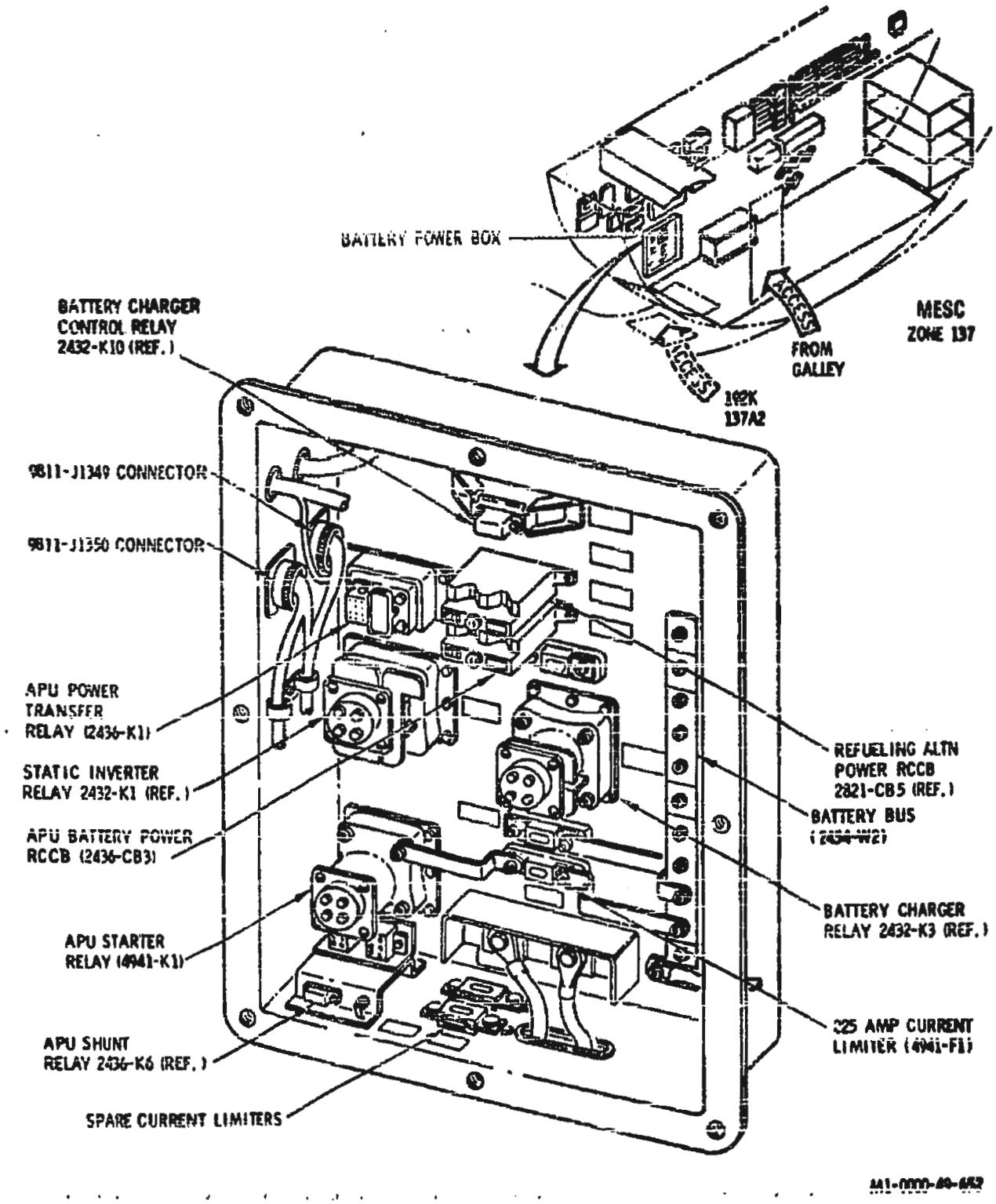


M1-4502-49-653

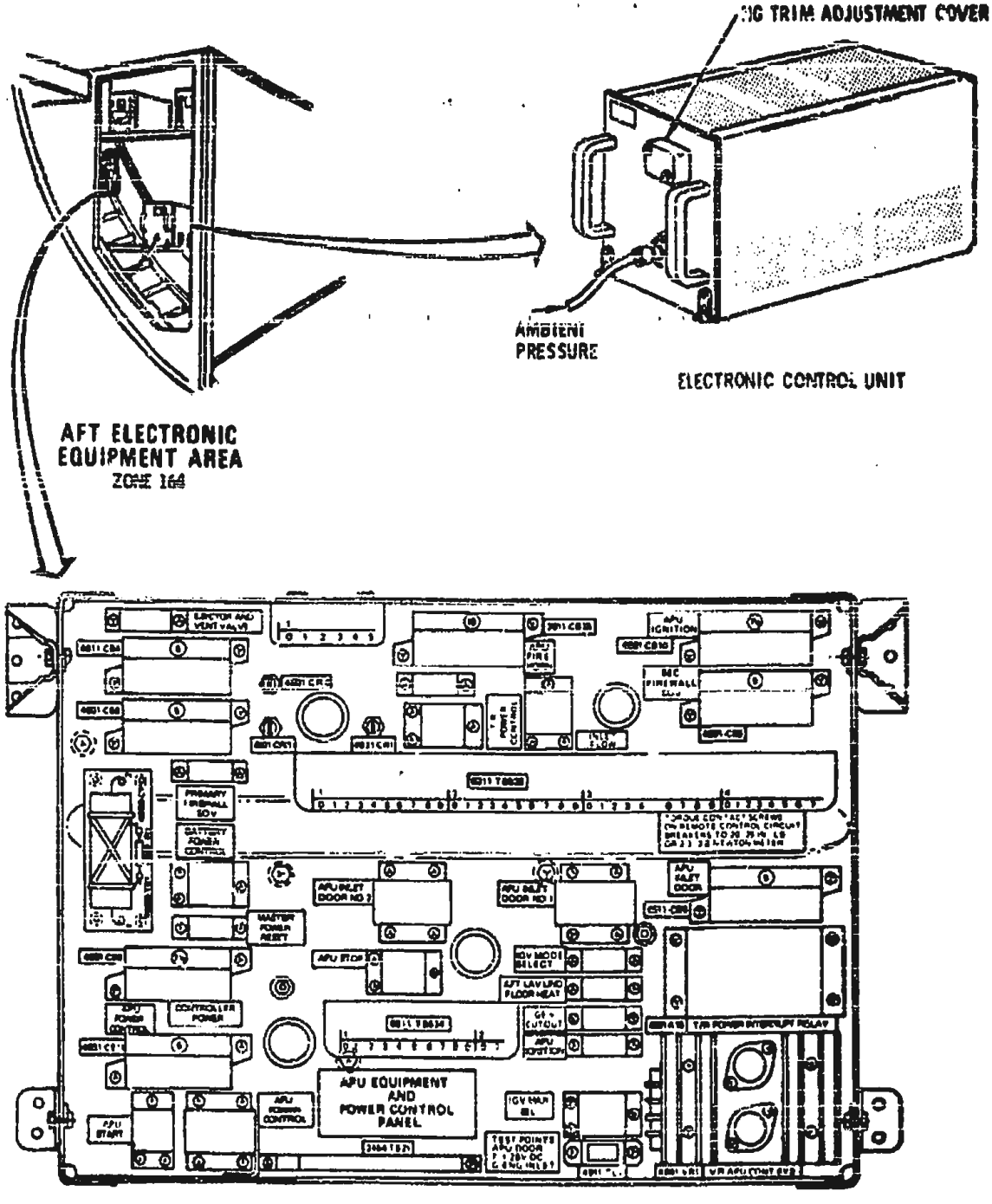
APU Components Locator
Figure 102 (Sheet 3)


BATTERY POWER BOX
MESC
ZONE 137
FROM GALLEY ACCESS
ACCESS
192K
137A2
BATTERY CHARGER CONTROL RELAY 2432-K10 (REF.)
APU POWER TRANSFER RELAY (2436-K1)
STATIC INVERTER RELAY 2432-K1 (REF.)
APU BATTERY POWER RCCB (2436-CB3)
APU STARTER RELAY (4941-K1)
APU SHUNT RELAY 2435-K6 (REF.)
SPARE CURRENT LIMITERS
APU TANK VALVE AND BOOST PUMP RCCB (REF.) 1
REFUELING ALTN POWER RCCB 2821-CB5 (REF.)
BATTERY CHARGER RELAY 2432-K3 (REF.)
CURRENT LIMITER 2432-F2 (REF.)
BATTERY BUS (2454-W2)
225 AMP CURRENT LIMITER (4941-F1)
NOTE
1 IF INSTALLED, THIS RCCB IS DEACTIVATED BY SB 28-019

APU Components Locator
Figure 102 (Sheet 4)



APU Components Locator
Figure 102 (Sheet 4)

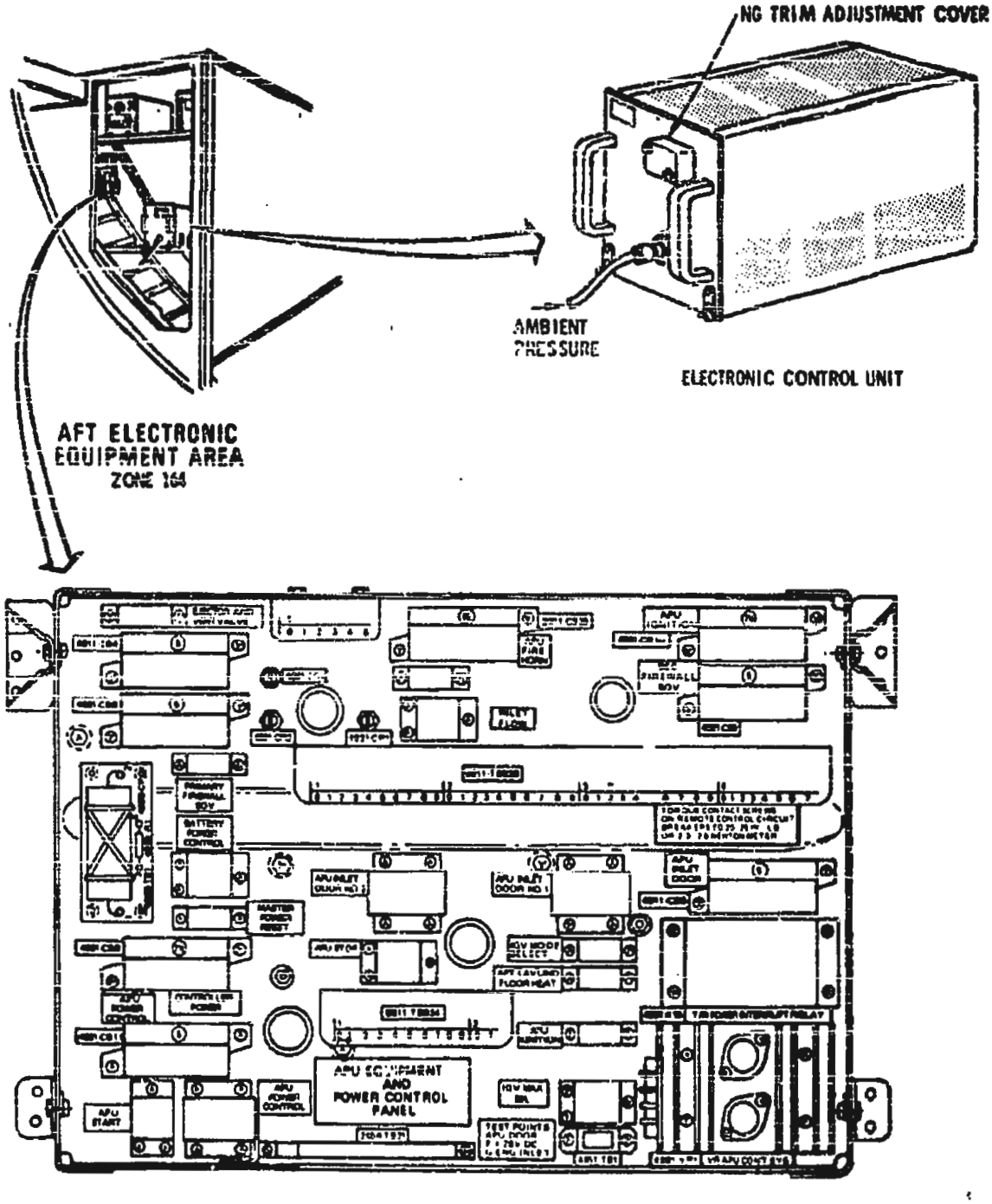


NOTE

1 PANEL WIRING NOT SHOWN

M1-17401-49-654

APU Components Locator
Figure 102 (Sheet 5)

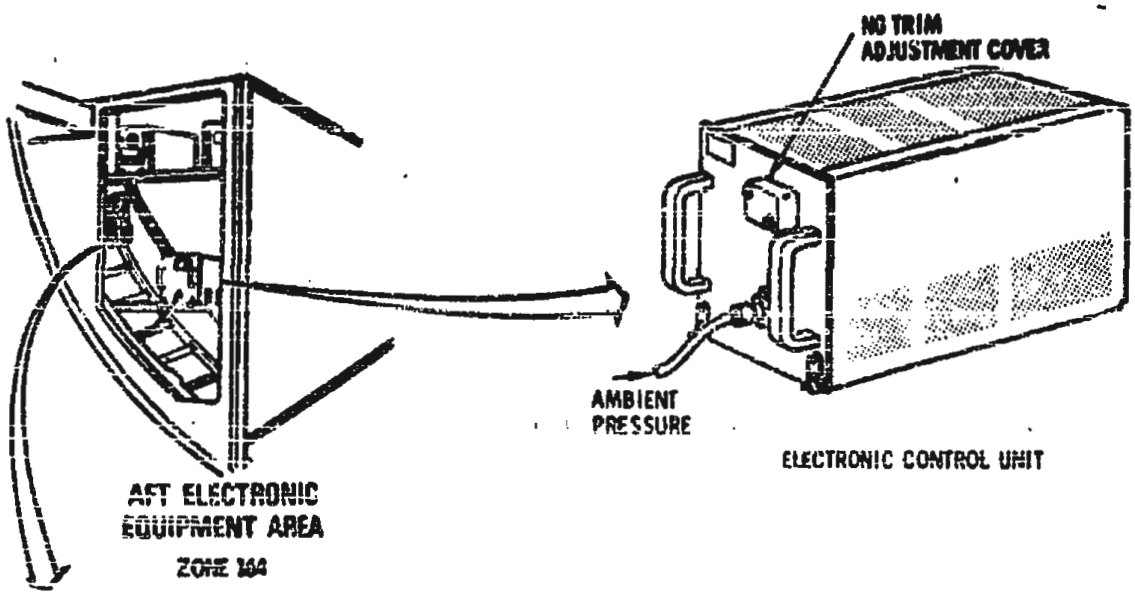

NG TRIM ADJUSTMENT COVER
AMBIENT PRESSURE
ELECTRONIC CONTROL UNIT
AFT ELECTRONIC EQUIPMENT AREA ZONE 164
APU EQUIPMENT AND POWER CONTROL PANEL

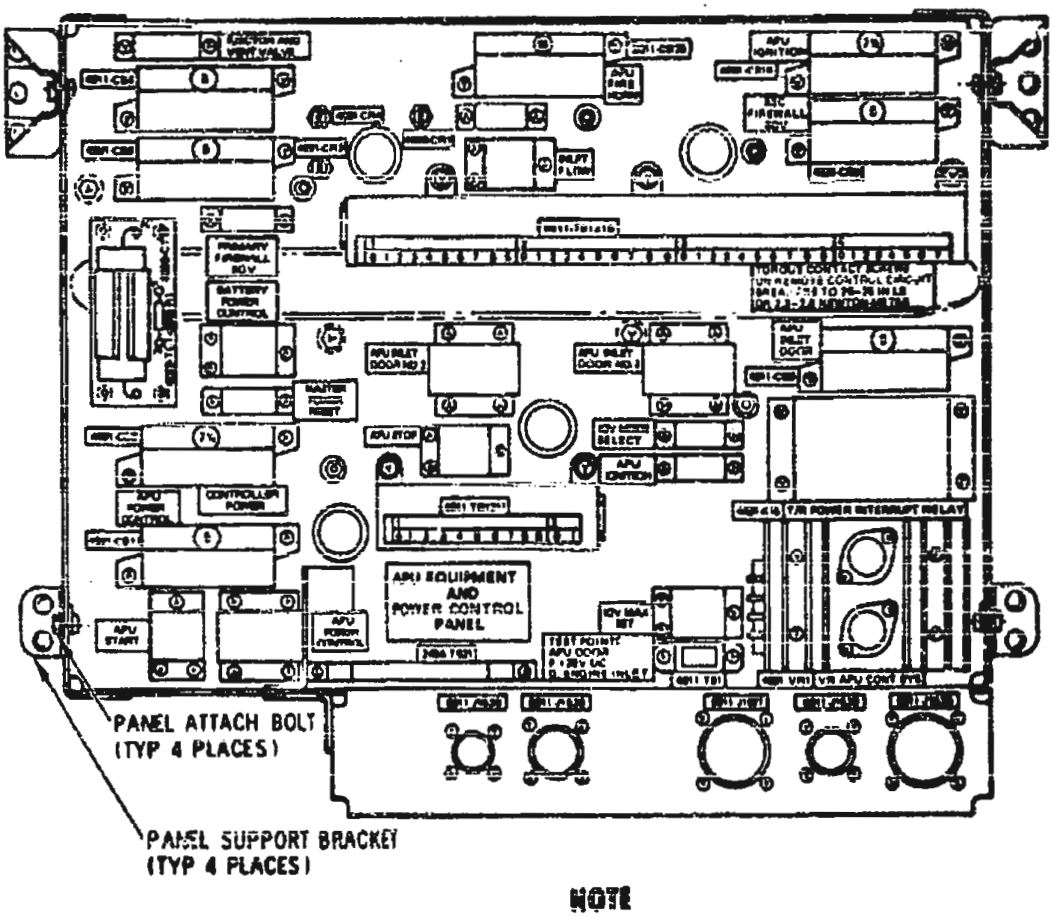
NOTE

1. PANEL WIRING NOT SHOWN

MI-58201-49-695

APU Components Locator
Figure 102 (Sheet 5)



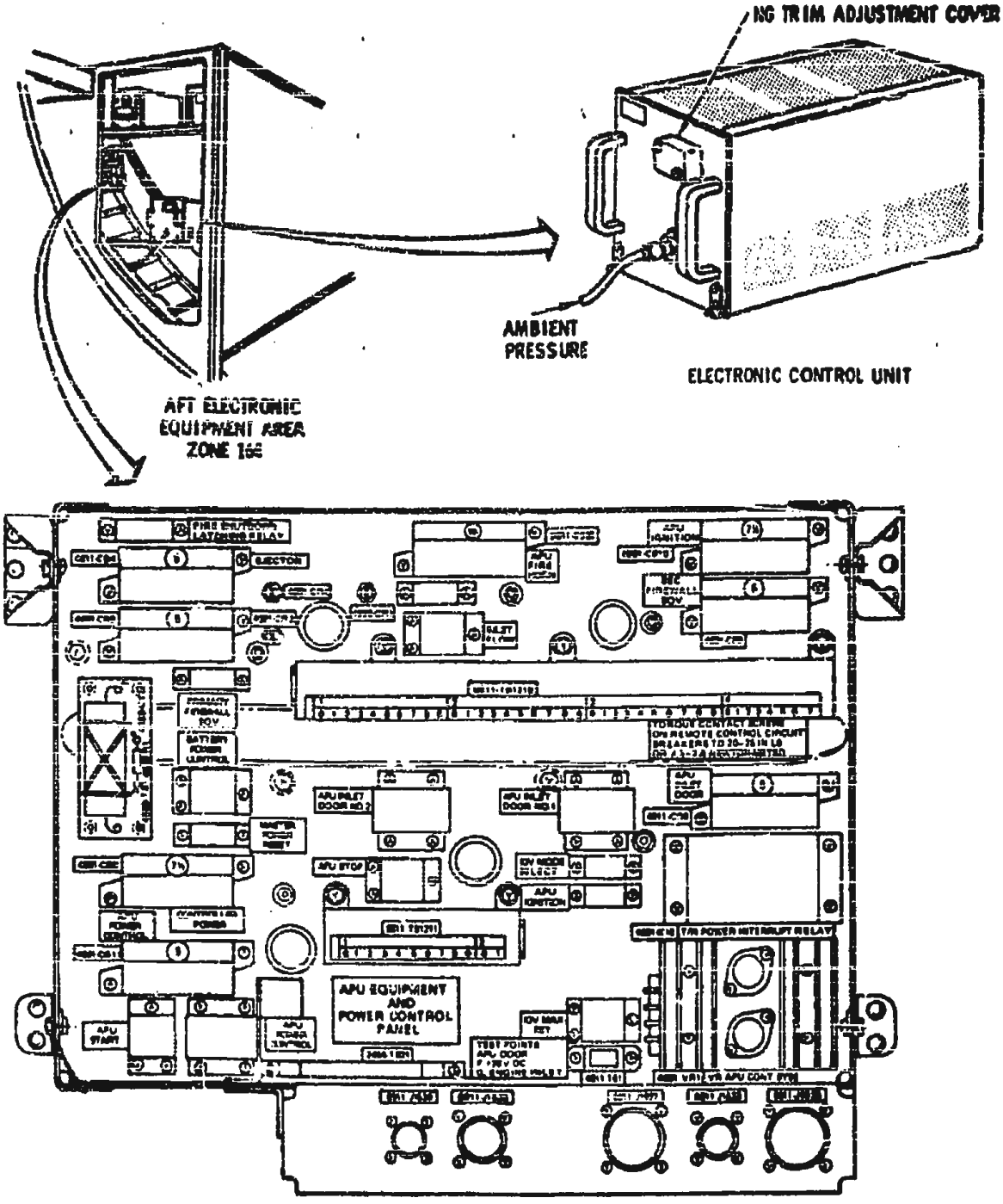


NOTE

1 PANEL WIRING NOT SHOWN.

M1-4501-49-555

APU Components Locator
Figure 102 (Sheet 5)

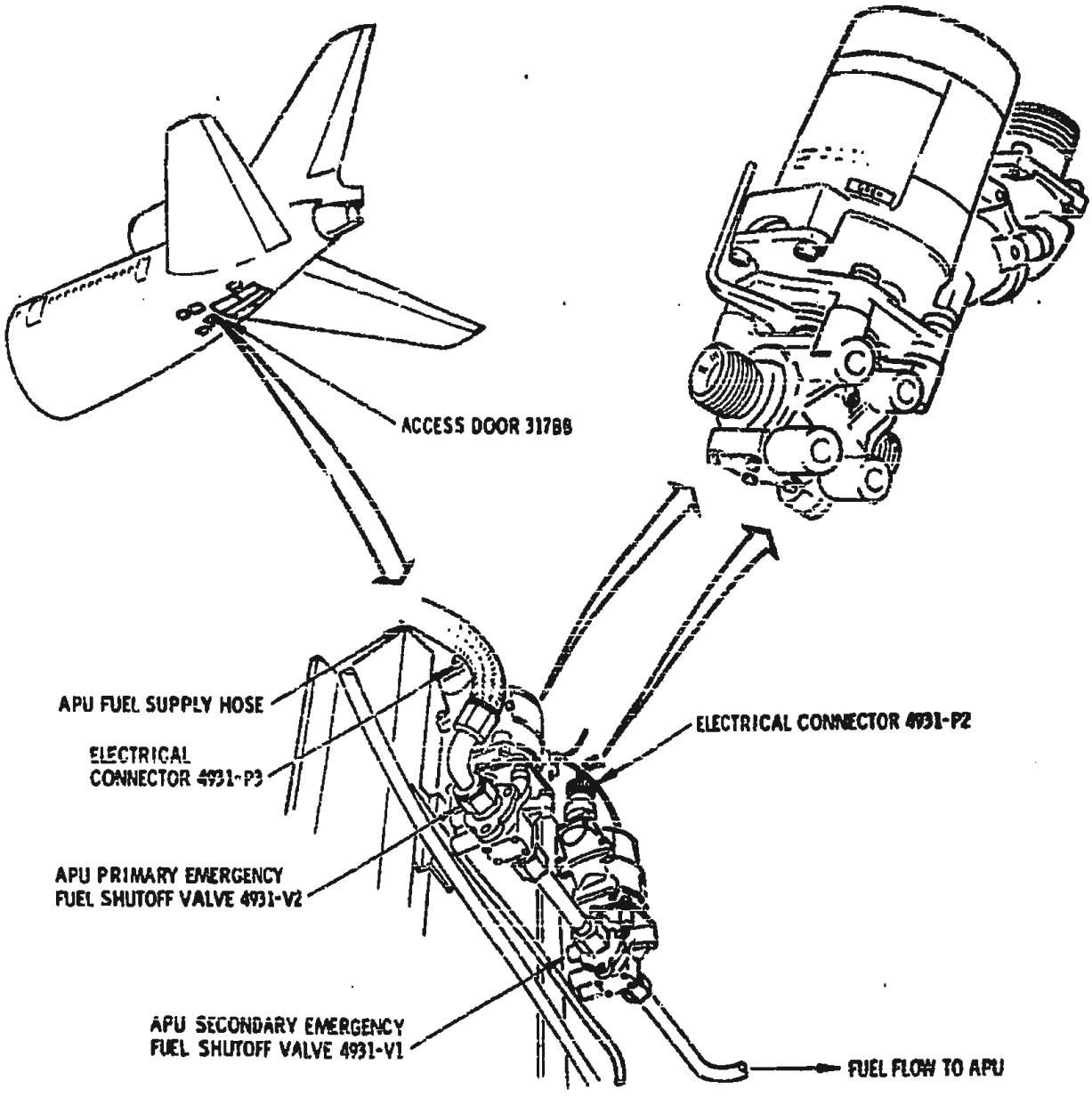

NG TRIM ADJUSTMENT COVER
AMBIENT PRESSURE
ELECTRONIC CONTROL UNIT
AFT ELECTRONIC EQUIPMENT AREA ZONE 166
APU EQUIPMENT AND POWER CONTROL PANEL

NOTE

1 PANEL WIRING NOT SHOWN

M1-0000-49-

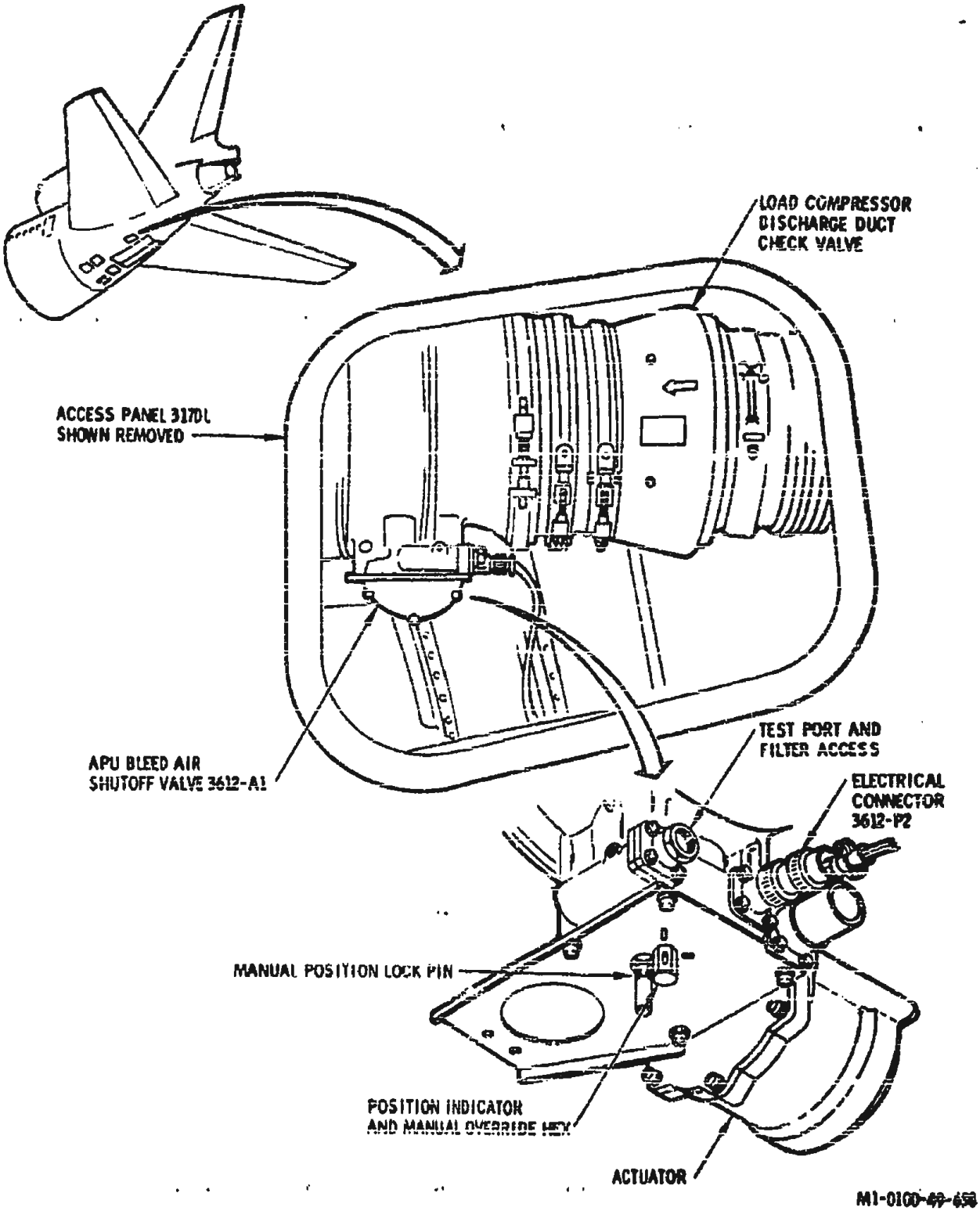
APU Component Locator
Figure 102 (Sheet 5)


ACCESS DOOR 3178B
APU FUEL SUPPLY HOSE
ELECTRICAL CONNECTOR 4931-P3
APU PRIMARY EMERGENCY FUEL SHUTOFF VALVE 4931-V2
APU SECONDARY EMERGENCY FUEL SHUTOFF VALVE 4931-V1
ELECTRICAL CONNECTOR 4931-P2
FUEL FLOW TO APU

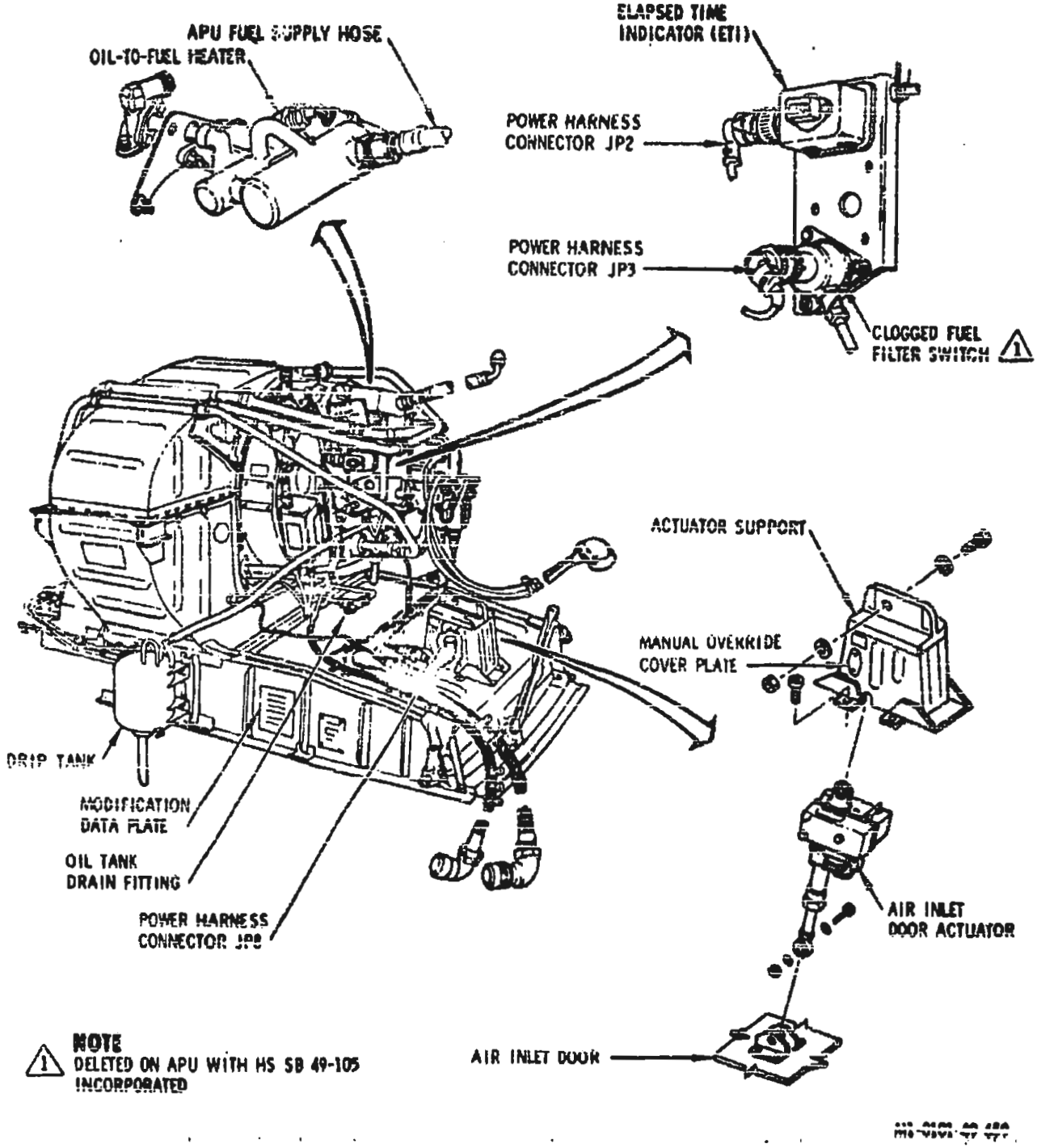
APU PRIMARY AND SECONDARY EMERGENCY FUEL SHUTOFF VALVES
(VIEW THROUGH ACCESS 3178B)

M1-0100-49-657

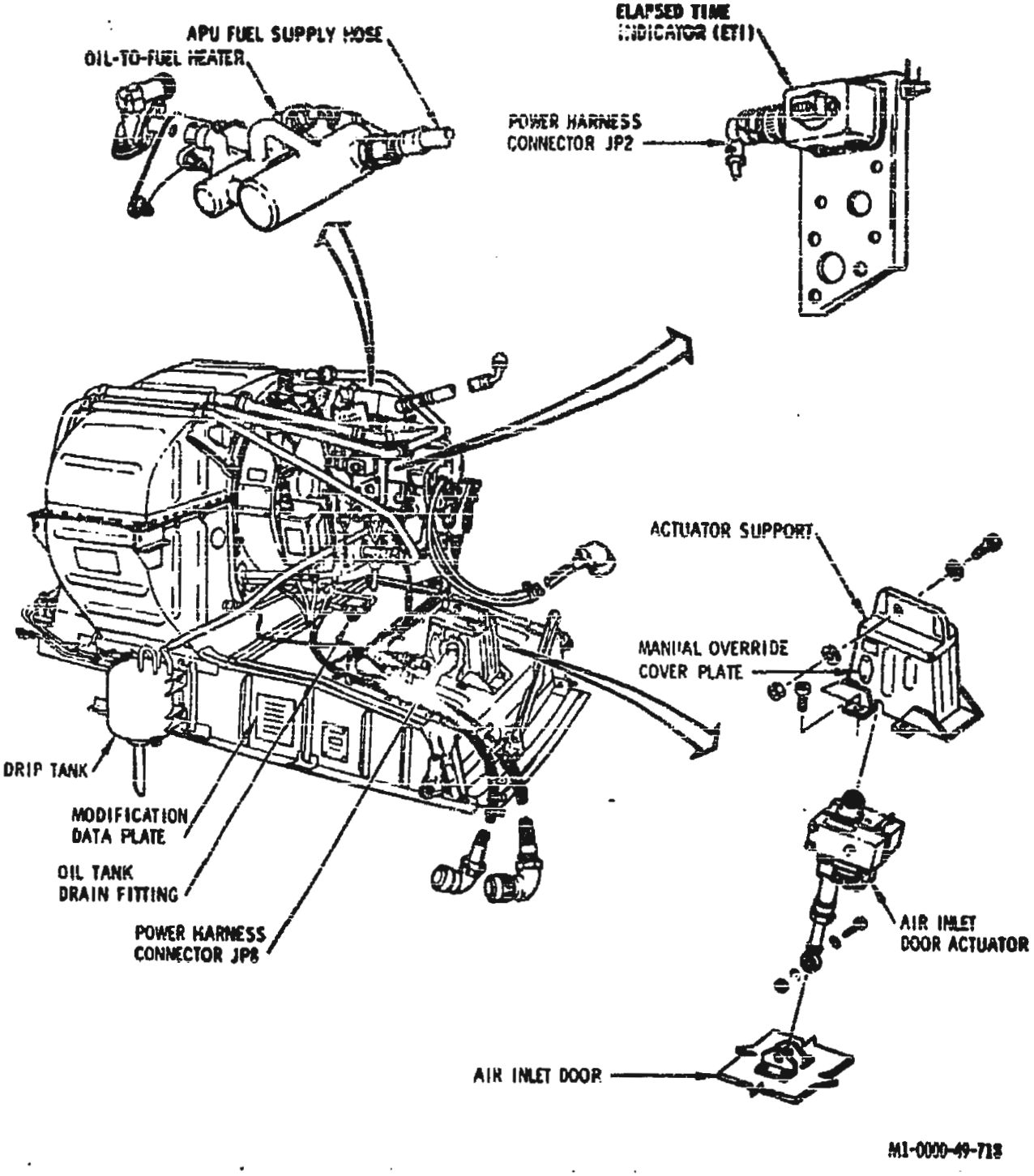
APU Components Locator
Figure 102 (Sheet 6)



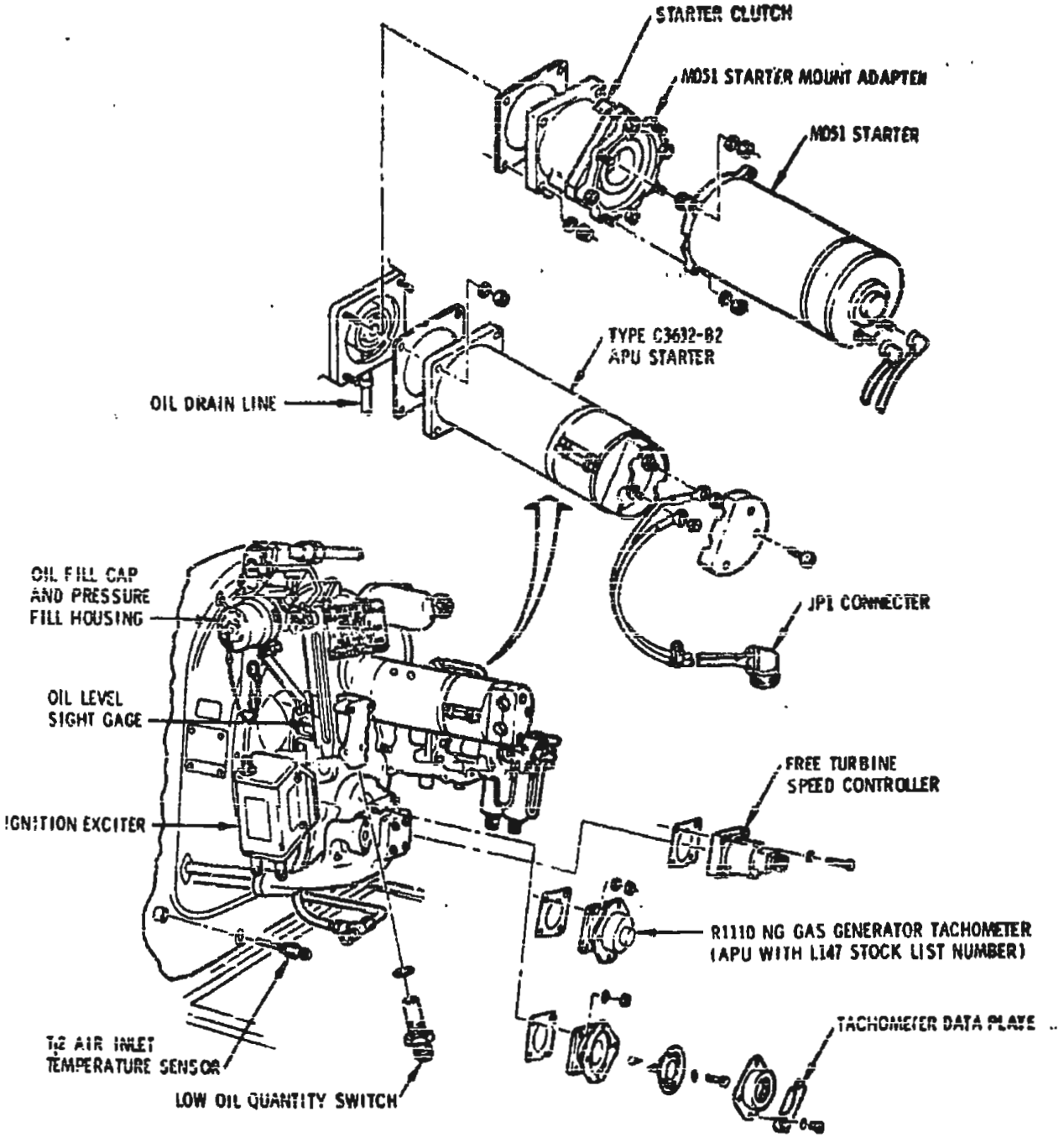
APU Components Locator
Figure 102 (Sheet 7)



APU Components Locator
Figure 102 (Sheet 8)



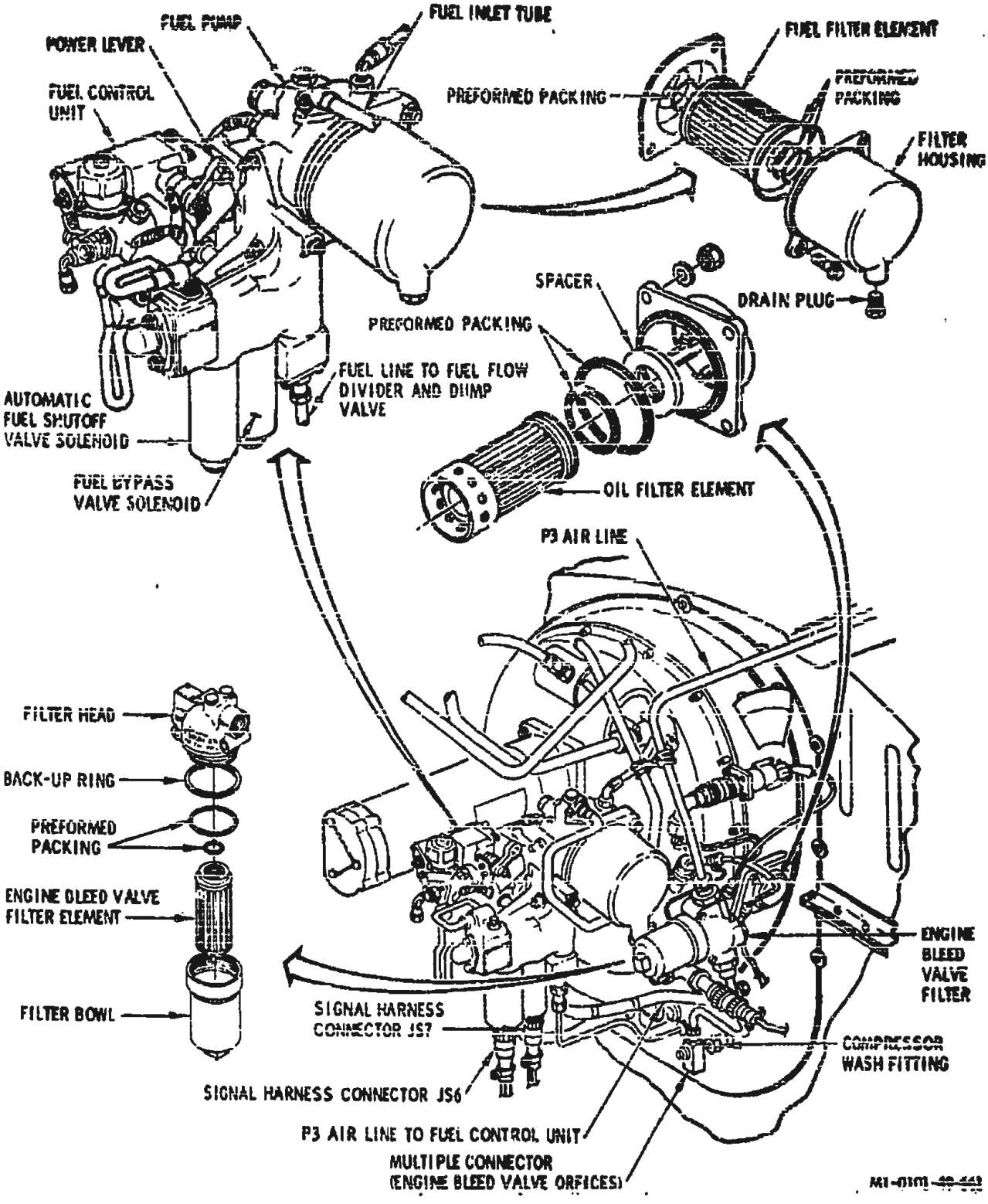
APU Components Locator
Figure 102 (Sheet 8)



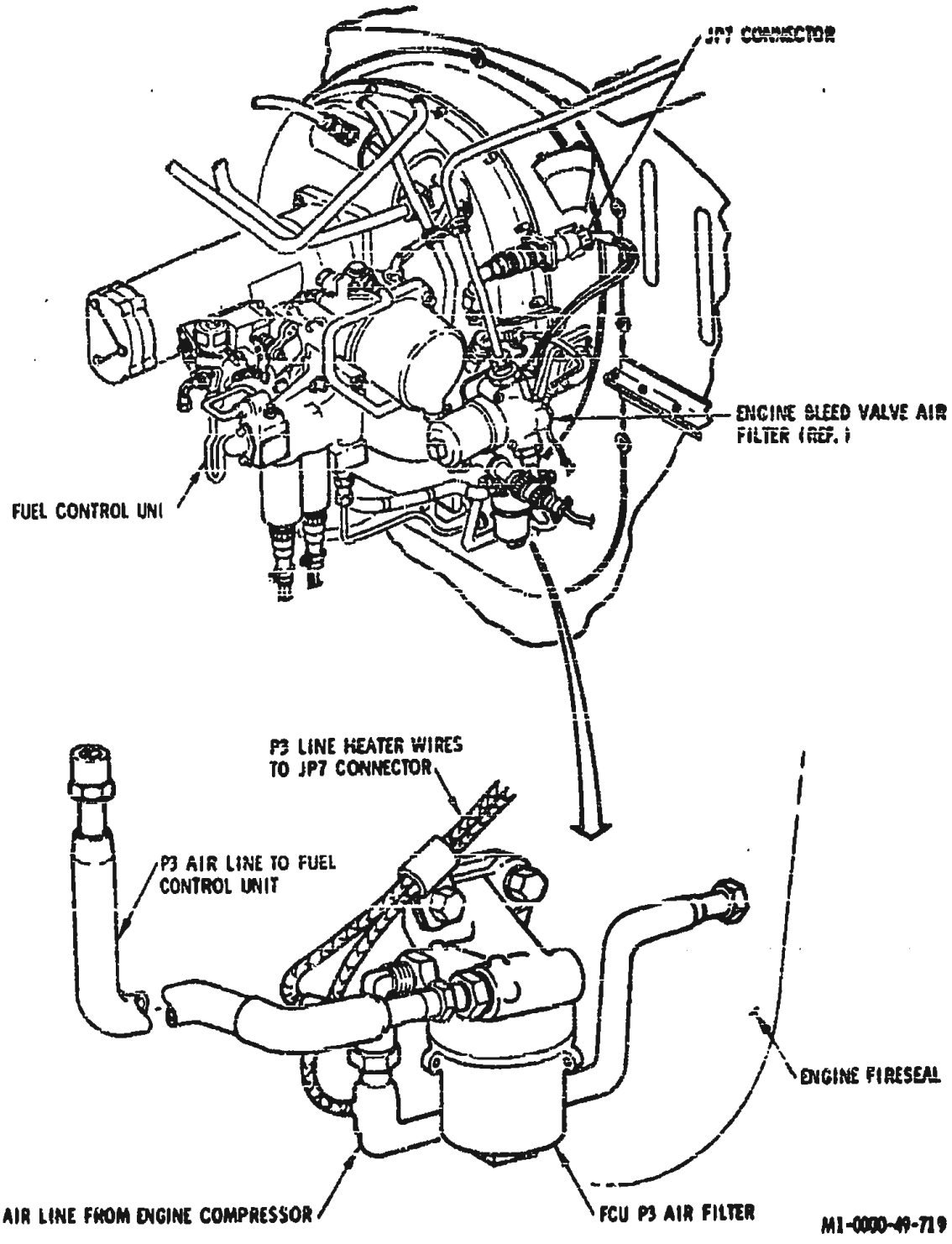
NG GAS GENERATOR TACHOMETER

M1-0000-49-912

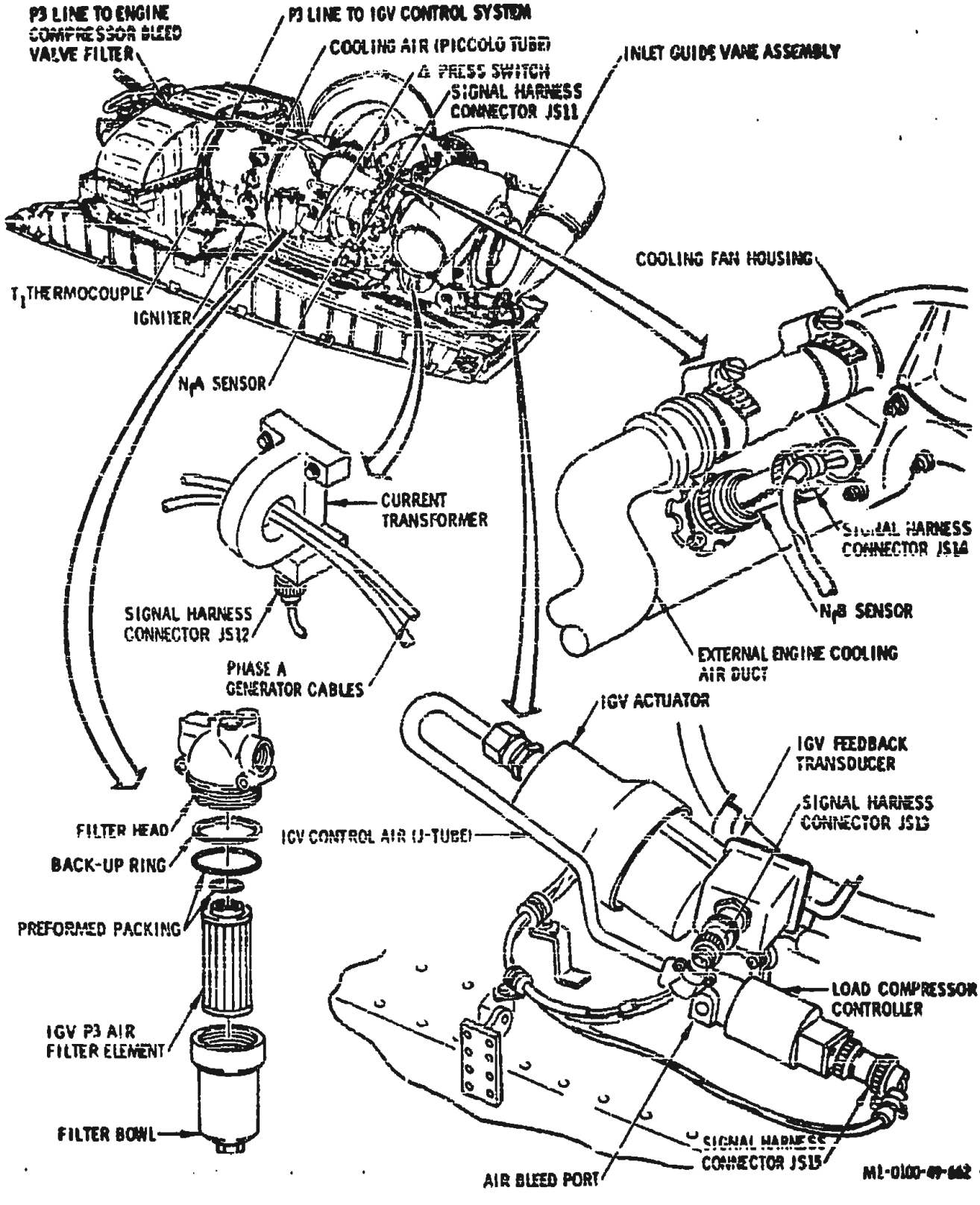
C
C APU Components Locator
Figure 102 (Sheet 9)



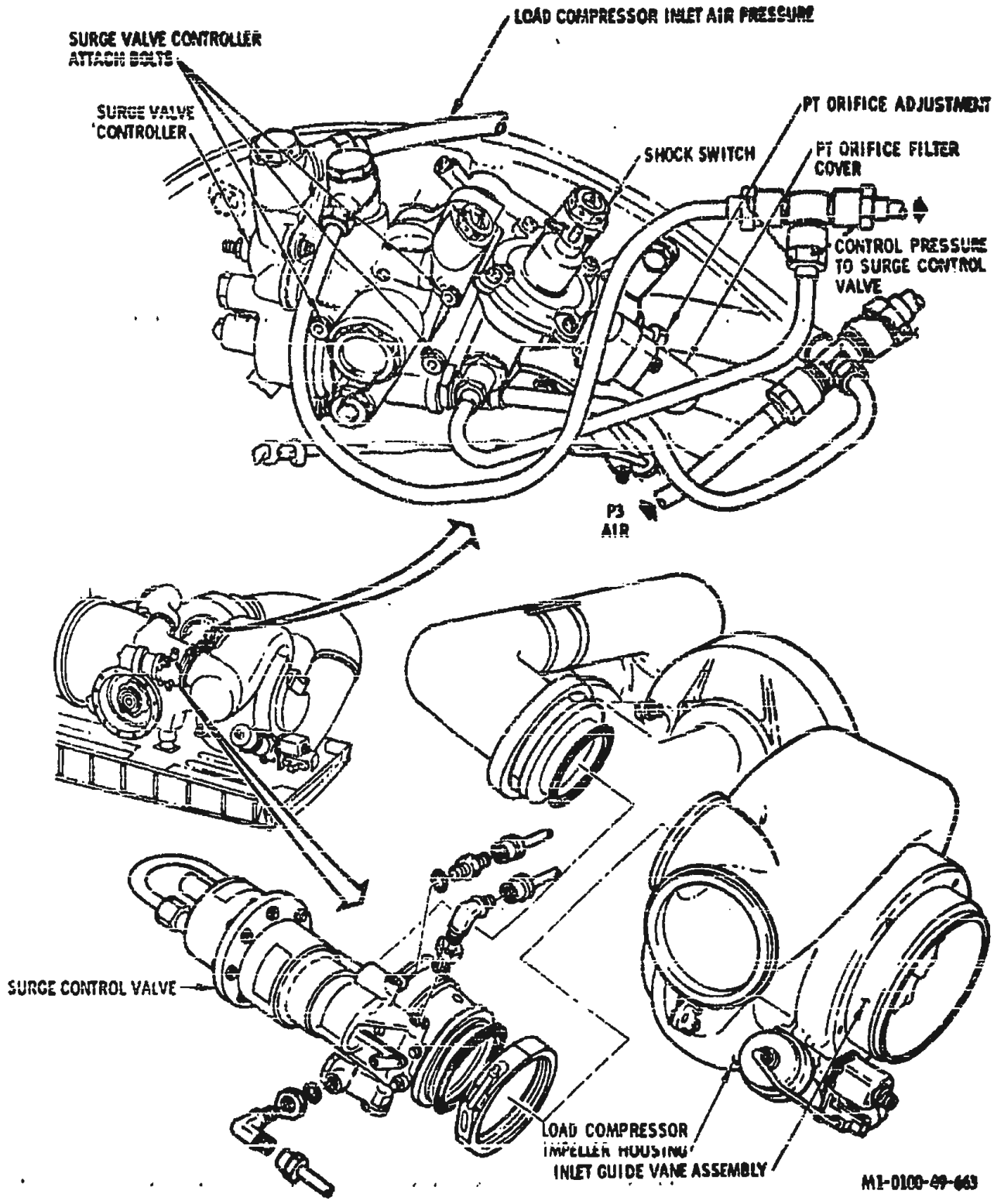
APU Components Locator
Figure 102 (Sheet 10)


JP7 CONNECTOR
ENGINE BLEED VALVE AIR FILTER (REF.)
FUEL CONTROL UNI
P3 LINE HEATER WIRES TO JP7 CONNECTOR
P3 AIR LINE TO FUEL CONTROL UNIT
ENGINE FIRESEAL
P3 AIR LINE FROM ENGINE COMPRESSOR
FCU P3 AIR FILTER
M1-0000-49-719

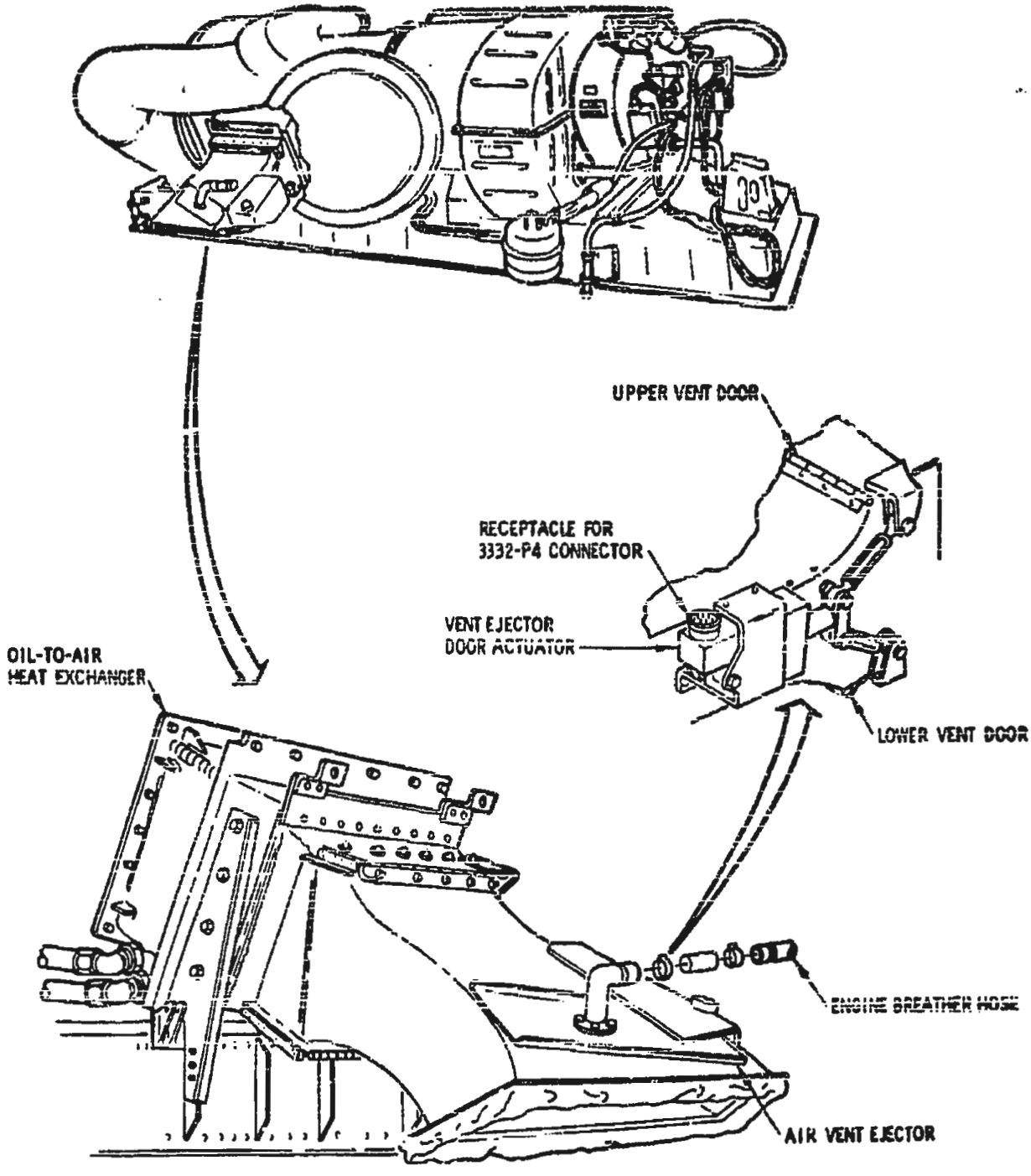
APU Components Locator
Figure 102 (Sheet 11)



APU Components Locator
Figure 102 (Sheet 12)

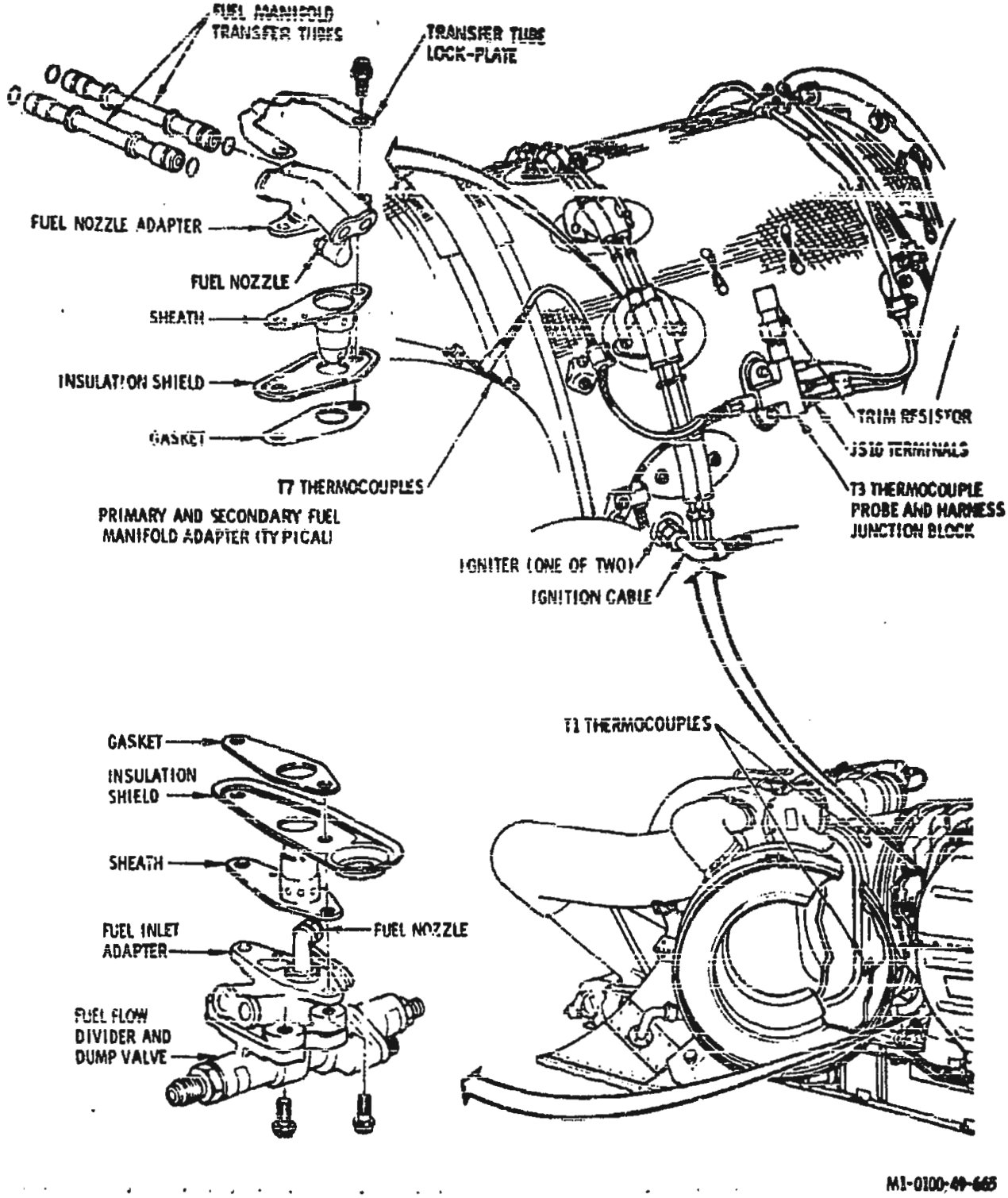


APU Components Locator
Figure 102 (Sheet 13)

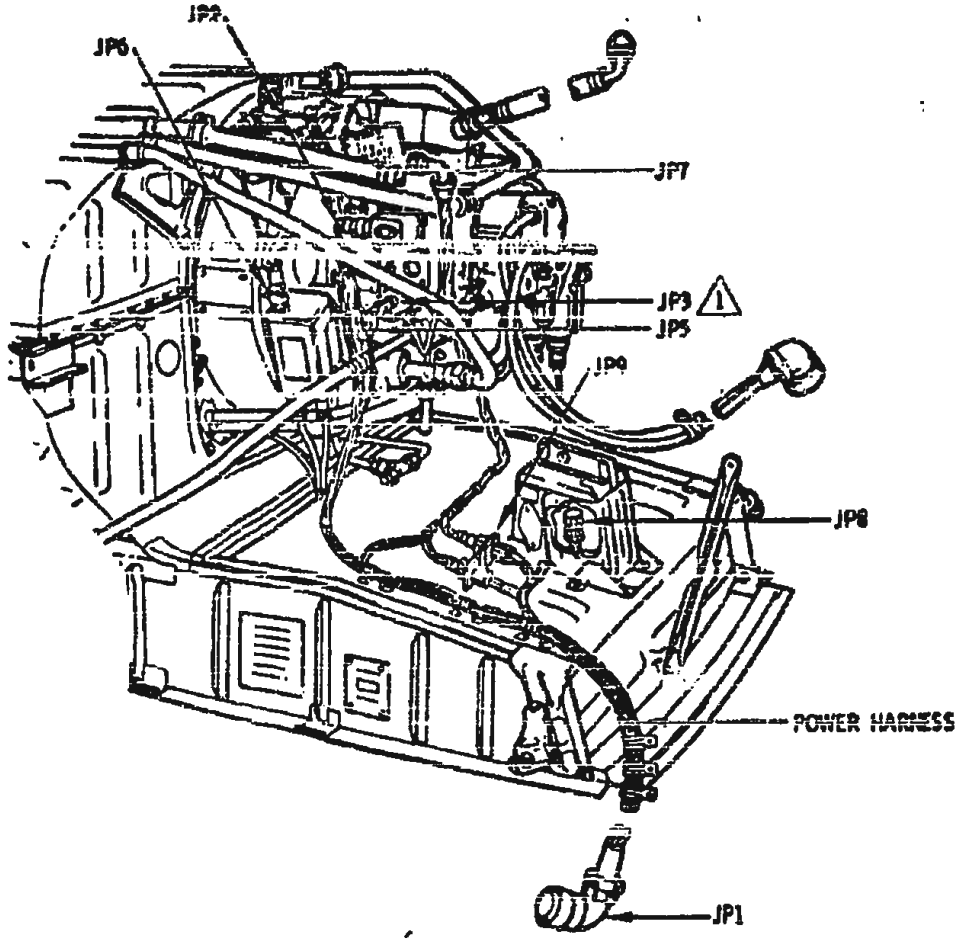


M1-0100-49-664.

APU Components Locator
Figure 102 (Sheet 14)



APU Components Locator
Figure 102 (Sheet 15)



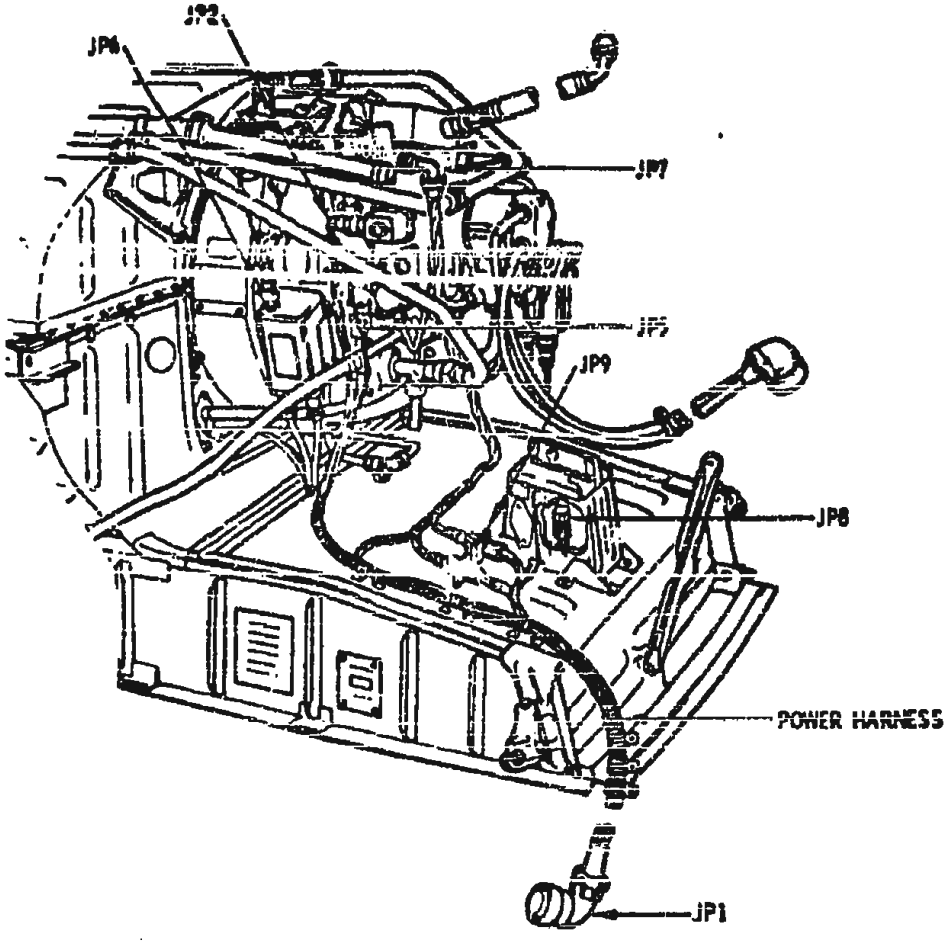
CONNECTOR DESIGNATION	POWER HARNESS CONNECTOR
JP1	FIREWALL CONNECTOR
JP2	ELAPSED TIME INDICATOR
JP3	CLOGGED FUEL FILTER 1
JP5	FLOAT SWITCH (LOW OIL QUANTITY)
JP6	IGNITION EXCITER
JP7	P3 LINE HEATER
JP8	ENGINE INLET DOOR ACTUATOR
JP9	ΔP HARNESS TO POWER HARNESS INTERCONNECT

NOTE

1 DELETED ON APU WITH HS SB 49-105

M1-0001-49-666

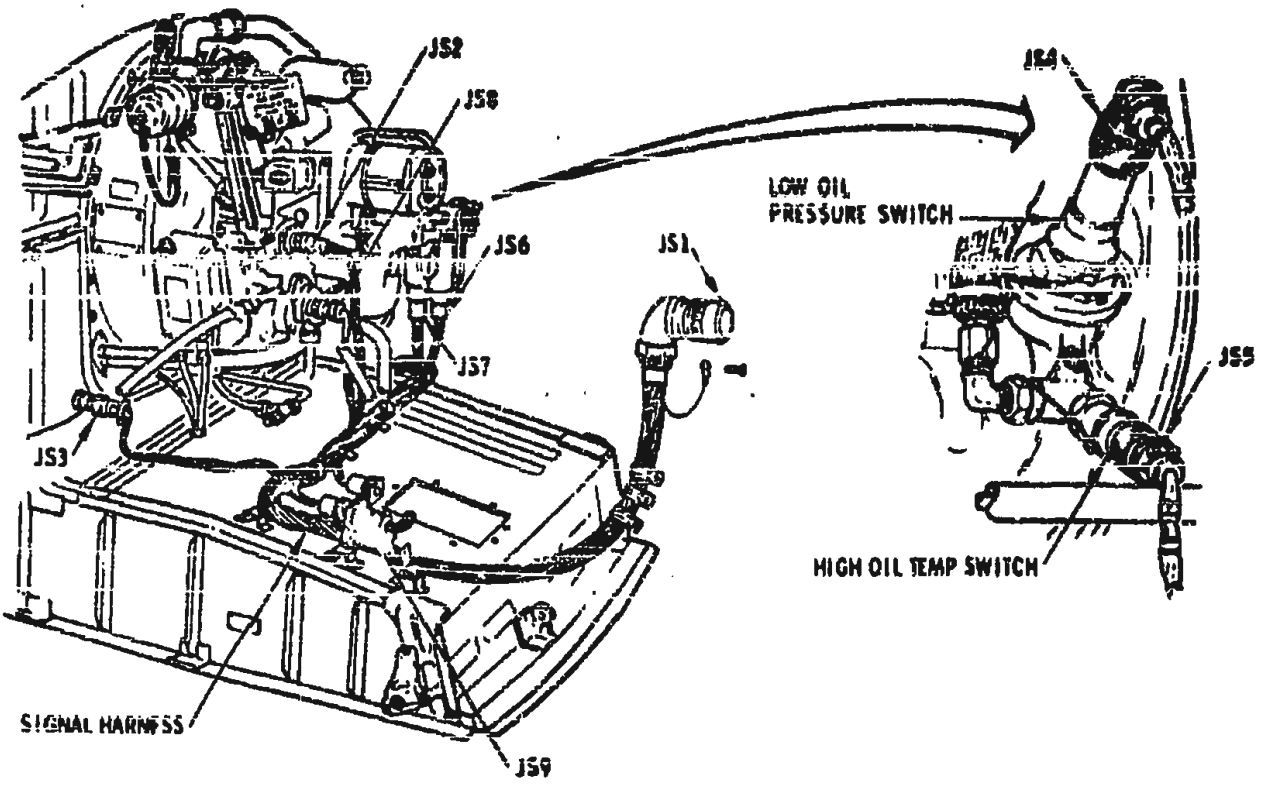
APU Components Locator
Figure 102 (Sheet 16)



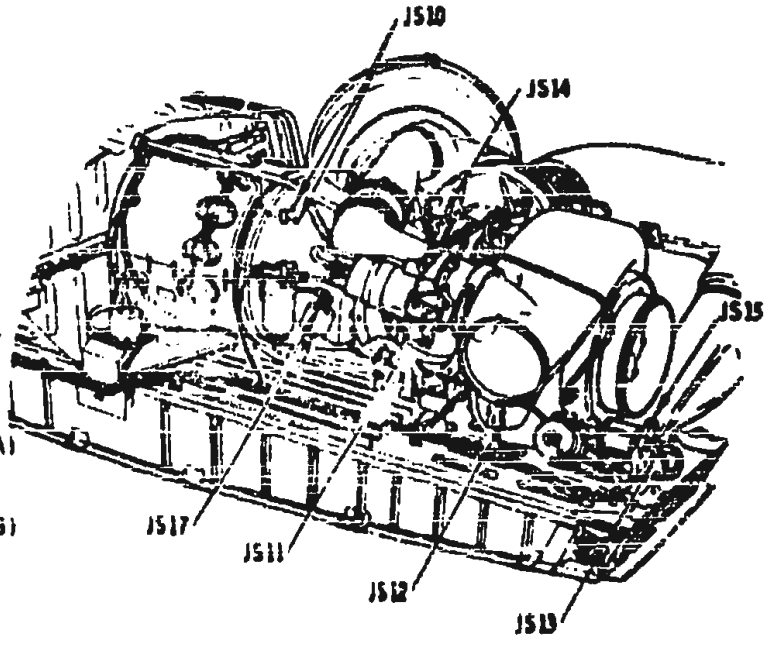
CONNECTOR DESIGNATION	POWER HARNESS CONNECTOR
JP1	FIREWALL CONNECTOR
JP2	ELAPSED TIME INDICATOR
JP5	FLOAT SWITCH (LOW OIL QUANTITY)
JP6	IGNITION EXCITER
JP7	P3 LINE HEATER
JP8	ENGINE INLET DOOR ACTUATOR
JP9	△P HARNESS TO POWER HARNESS INTERCONNECT

M1-0000-49-716

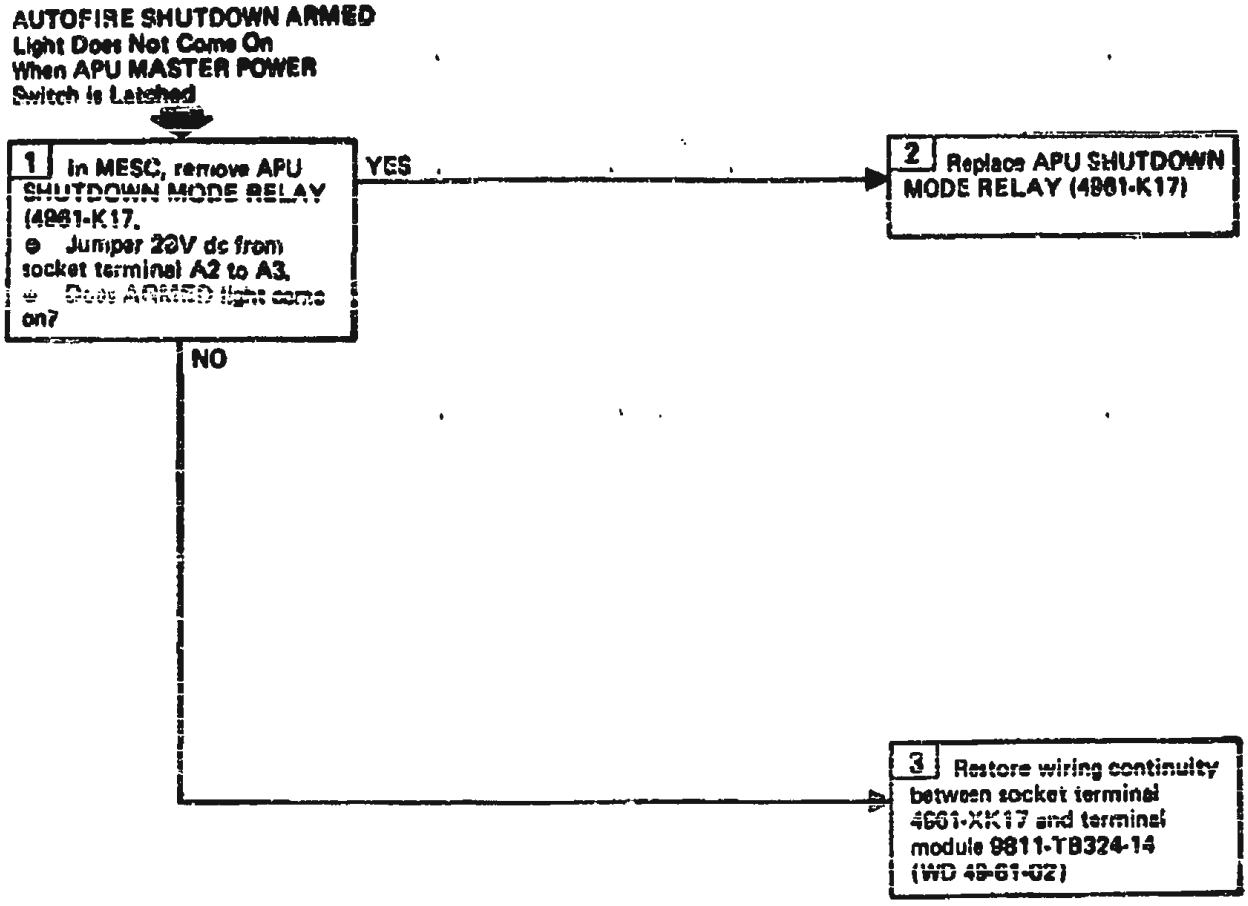
APU Components Locator
Figure 102 (Sheet 16)



CONNECTOR DESIGNATION	SIGNAL HARNESS CONNECTOR
JS1	FIREWALL CONNECTOR (SIGNAL)
JS2	FREE TURBINE SPEED CONTROLLER (N_f SPEED)
JS3	INLET TEMPERATURE SENSOR
JS4	LOW OIL PRESS. SWITCH
JS5	HIGH OIL TEMP SWITCH
JS6	FUEL SHUTOFF VALVE SOLENOID
JS7	FUEL BYPASS VALVE SOLENOID
JS8	GAS GENERATOR TACHOMETER
JS9	ΔP HARNESS TO SIGNAL HARNESS INTERCONNECT
JS10	T_1, T_3, T_7 TEMPERATURE SENSING HARNESS (TGT)
JS11	FREE TURBINE SPEED SENSOR (N_fA)
JS12	CURRENT TRANSFORMER
JS13	IGV FEEDBACK TRANSDUCER
JS14	FREE TURBINE SPEED SENSOR (N_fB)
JS15	LOAD COMPRESSOR CONTROLLER



APU Components Locator
Figure 102 (Sheet 17)

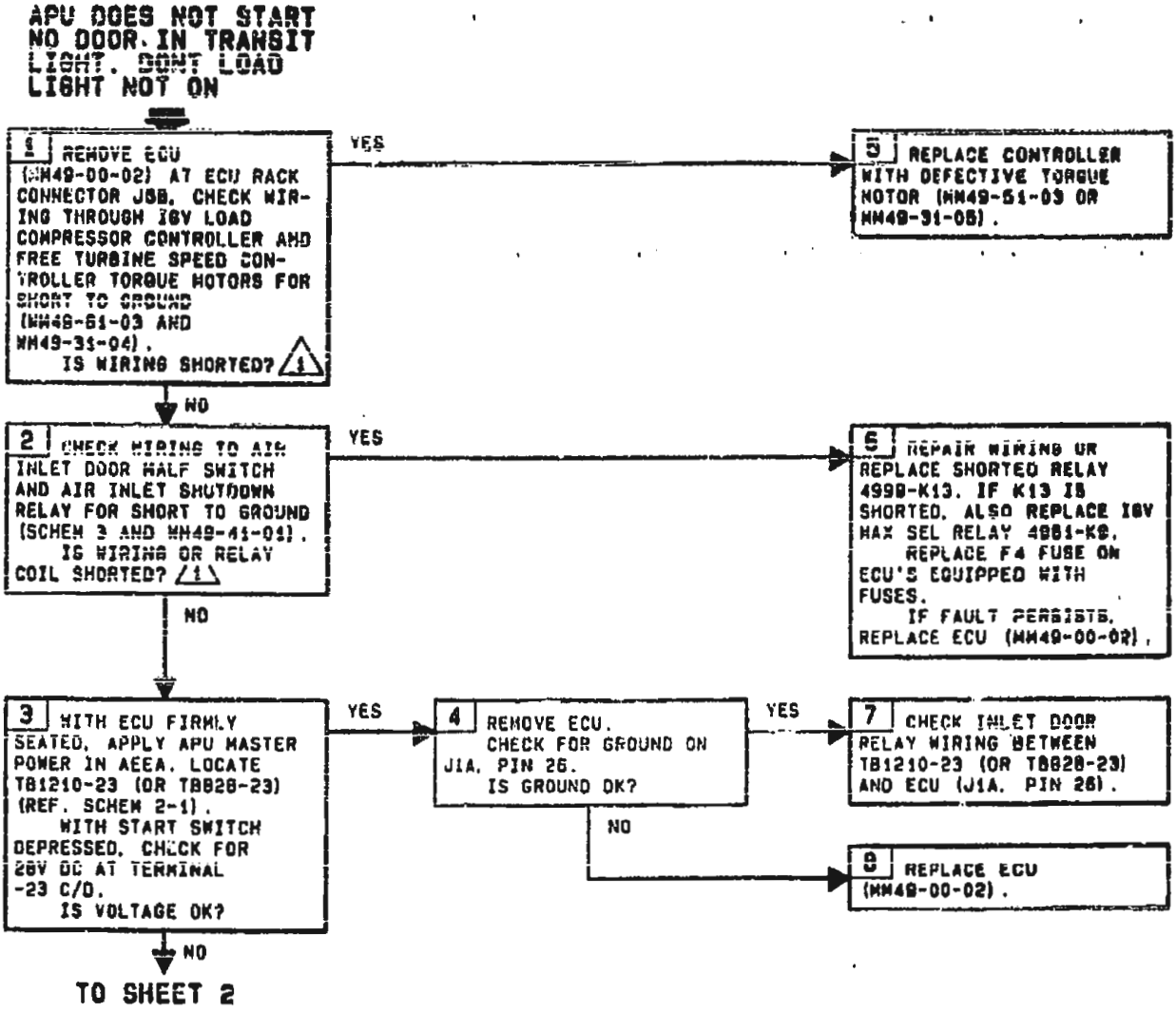

AUTOFIRE SHUTDOWN ARMED Light Does Not Come On When APU MASTER POWER Switch is Latched
1 In MESC, remove APU SHUTDOWN MODE RELAY (4961-K17.
Jumper 28V dc from socket terminal A2 to A3.
Does ARMED light come on?
YES
2 Replace APU SHUTDOWN MODE RELAY (4961-K17)
NO
3 Restore wiring continuity between socket terminal 4961-XK17 and terminal module 9811-TB324-14 (WD 49-61-02)

PREREQUISITES
External electrical power (24-41-00)
APU MASTER POWER on
AUTOFIRE SHUTDOWN switchlight
FE/SO panel lights test OK
latched in AUTO mode position
CB's: CB2-L8
CB3-B9 through B17

M1-0002-49-347

AUTOFIRE SHUTDOWN ARMED Light Does Not Come On When
APU MASTER POWER Switch is Latched
Figure 103

PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: APU CONTROL (MM49-00-01)


APU DOES NOT START
NO DOOR IN TRANSIT LIGHT, DONT LOAD LIGHT NOT ON
1 REMOVE ECU (MM49-00-02) AT ECU RACK CONNECTOR J5B. CHECK WIRING THROUGH IGV LOAD COMPRESSOR CONTROLLER AND FREE TURBINE SPEED CONTROLLER TORQUE MOTORS FOR SHORT TO GROUND (MM49-61-03 AND MM49-31-04).
IS WIRING SHORTED? 1
YES
5 REPLACE CONTROLLER WITH DEFECTIVE TORQUE MOTOR (MM49-61-03 OR MM49-31-05).
NO
2 CHECK WIRING TO AIR INLET DOOR HALF SWITCH AND AIR INLET SHUTDOWN RELAY FOR SHORT TO GROUND (SCHEM 3 AND MM49-41-04).
IS WIRING OR RELAY COIL SHORTED? 1
YES
6 REPAIR WIRING OR REPLACE SHORTED RELAY 4998-K13. IF K13 IS SHORTED, ALSO REPLACE IGV MAX SEL RELAY 4981-K8.
REPLACE F4 FUSE ON ECU'S EQUIPPED WITH FUSES.
IF FAULT PERSISTS, REPLACE ECU (MM49-00-02).
NO
3 WITH ECU FIRMLY SEATED, APPLY APU MASTER POWER IN AEEA. LOCATE TB1210-23 (OR TB828-23) (REF. SCHEM 2-1).
WITH START SWITCH DEPRESSED, CHECK FOR 28V DC AT TERMINAL -23 C/D.
IS VOLTAGE OK?
YES
4 REMOVE ECU.
CHECK FOR GROUND ON J1A, PIN 26.
IS GROUND OK?
YES
7 CHECK INLET DOOR RELAY WIRING BETWEEN TB1210-23 (OR TB828-23) AND ECU (J1A, PIN 26).
NO
8 REPLACE ECU (MM49-00-02).
NO
TO SHEET 2

NOTE

1 A BURNED OUT F4 FUSE ON ECU'S INCORPORATING HS SB49-158 WOULD BE POSITIVE INDICATION OF EXTERNALLY SHORTED ECU POWERED COMPONENTS.

M1-0003-49-003

R APU Does Not Start, No DOOR IN TRANSIT
R Light; DONT LOAD Light Not On
R Figure 104 (Sheet 1)

PREREQUISITES
SEE SHEET 1

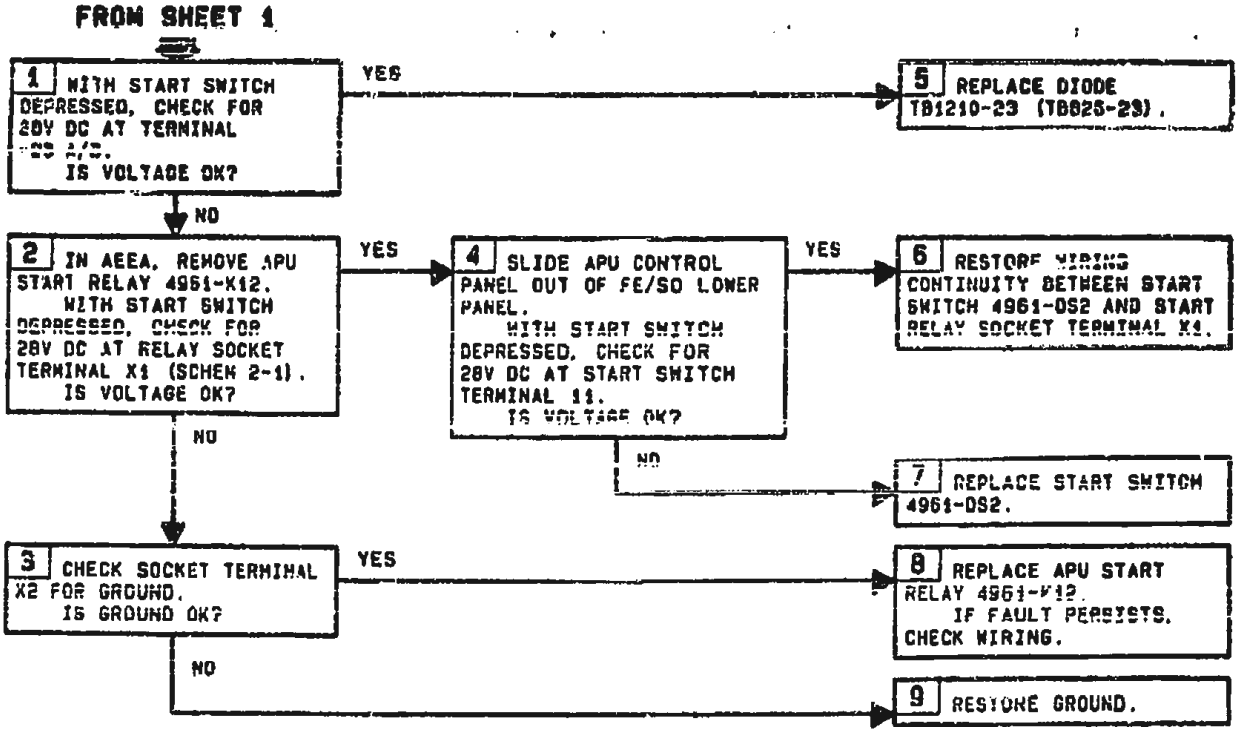
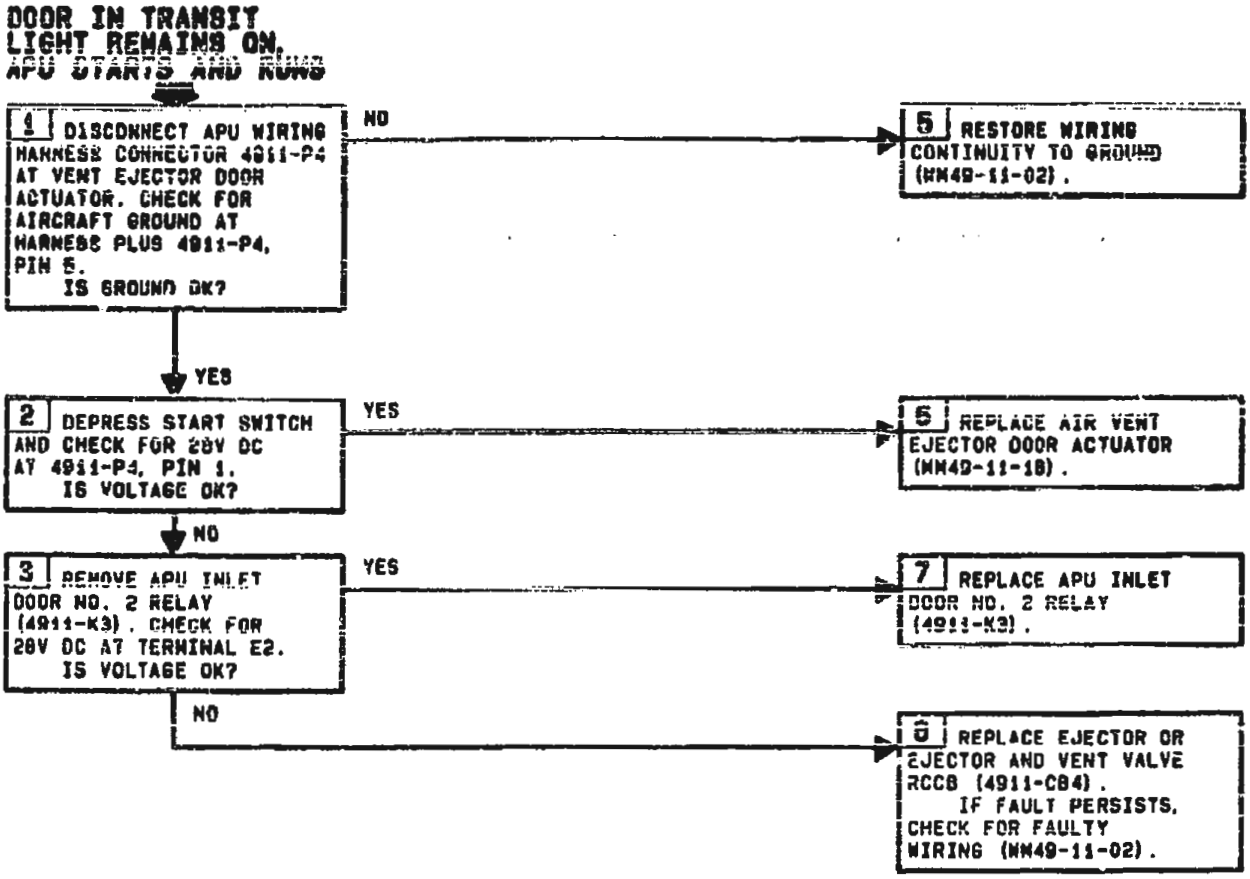

FROM SHEET 1
1 WITH START SWITCH DEPRESSED, CHECK FOR 28V DC AT TERMINAL [illegible]. IS VOLTAGE OK?
YES
5 REPLACE DIODE TB1210-23 (TB825-29).
NO
2 IN AEEA, REMOVE APU START RELAY 4961-K12. WITH START SWITCH DEPRESSED, CHECK FOR 28V DC AT RELAY SOCKET TERMINAL X1 (SCHEM 2-1). IS VOLTAGE OK?
YES
4 SLIDE APU CONTROL PANEL OUT OF FE/SO LOWER PANEL. WITH START SWITCH DEPRESSED, CHECK FOR 28V DC AT START SWITCH TERMINAL 11. IS VOLTAGE OK?
YES
6 RESTORE WIRING CONTINUITY BETWEEN START SWITCH 4961-DS2 AND START RELAY SOCKET TERMINAL X1.
NO
7 REPLACE START SWITCH 4961-DS2.
NO
3 CHECK SOCKET TERMINAL X2 FOR GROUND. IS GROUND OK?
YES
8 REPLACE APU START RELAY 4961-K12. IF FAULT PERSISTS, CHECK WIRING.
NO
9 RESTORE GROUND.

FIGURE DELETED

PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
CB'S: CB3-B9 THROUGH B15, CB3-B15
REF: 49-11-00 SCHEM 2 (SHEET 1)
APU MASTER POWER ON


DOOR IN TRANSIT LIGHT REMAINS ON, APU STARTS AND RUNS
1 DISCONNECT APU WIRING HARNESS CONNECTOR 4911-P4 AT VENT EJECTOR DOOR ACTUATOR. CHECK FOR AIRCRAFT GROUND AT HARNESS PLUG 4911-P4, PIN E. IS GROUND OK?
NO
5 RESTORE WIRING CONTINUITY TO GROUND (MM49-11-02).
YES
2 DEPRESS START SWITCH AND CHECK FOR 28V DC AT 4911-P4, PIN 1. IS VOLTAGE OK?
YES
6 REPLACE AIR VENT EJECTOR DOOR ACTUATOR (MM49-11-18).
NO
3 REMOVE APU INLET DOOR NO. 2 RELAY (4911-K3). CHECK FOR 28V DC AT TERMINAL E2. IS VOLTAGE OK?
YES
7 REPLACE APU INLET DOOR NO. 2 RELAY (4911-K3).
NO
8 REPLACE EJECTOR OR EJECTOR AND VENT VALVE RCCB (4911-CB4). IF FAULT PERSISTS, CHECK FOR FAULTY WIRING (MM49-11-02).

CAUTION

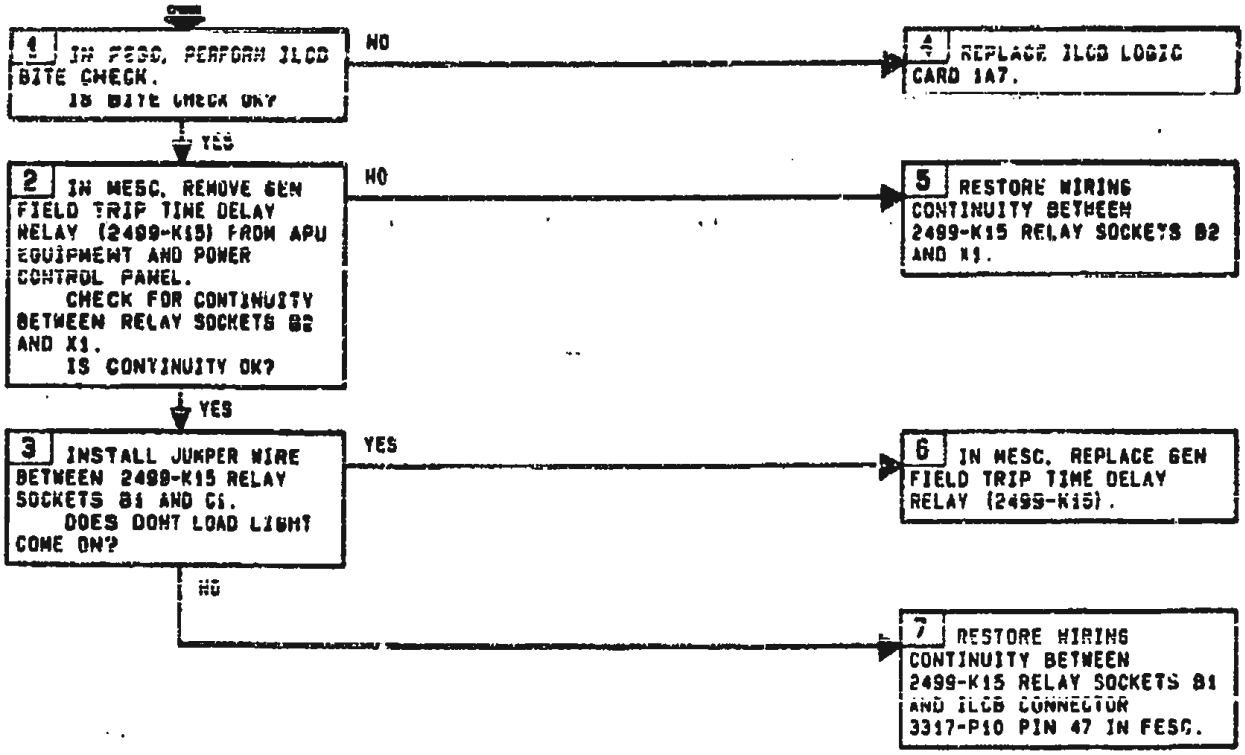
EXCEPT AS NECESSARY FOR TROUBLESHOOTING, DO NOT OPERATE APU ON GROUND WITH AIR VENT EJECTOR DOORS CLOSED

M1-0000-49-1011

DOOR IN TRANSIT Light Remains On, APU Starts and Runs
Figure 106

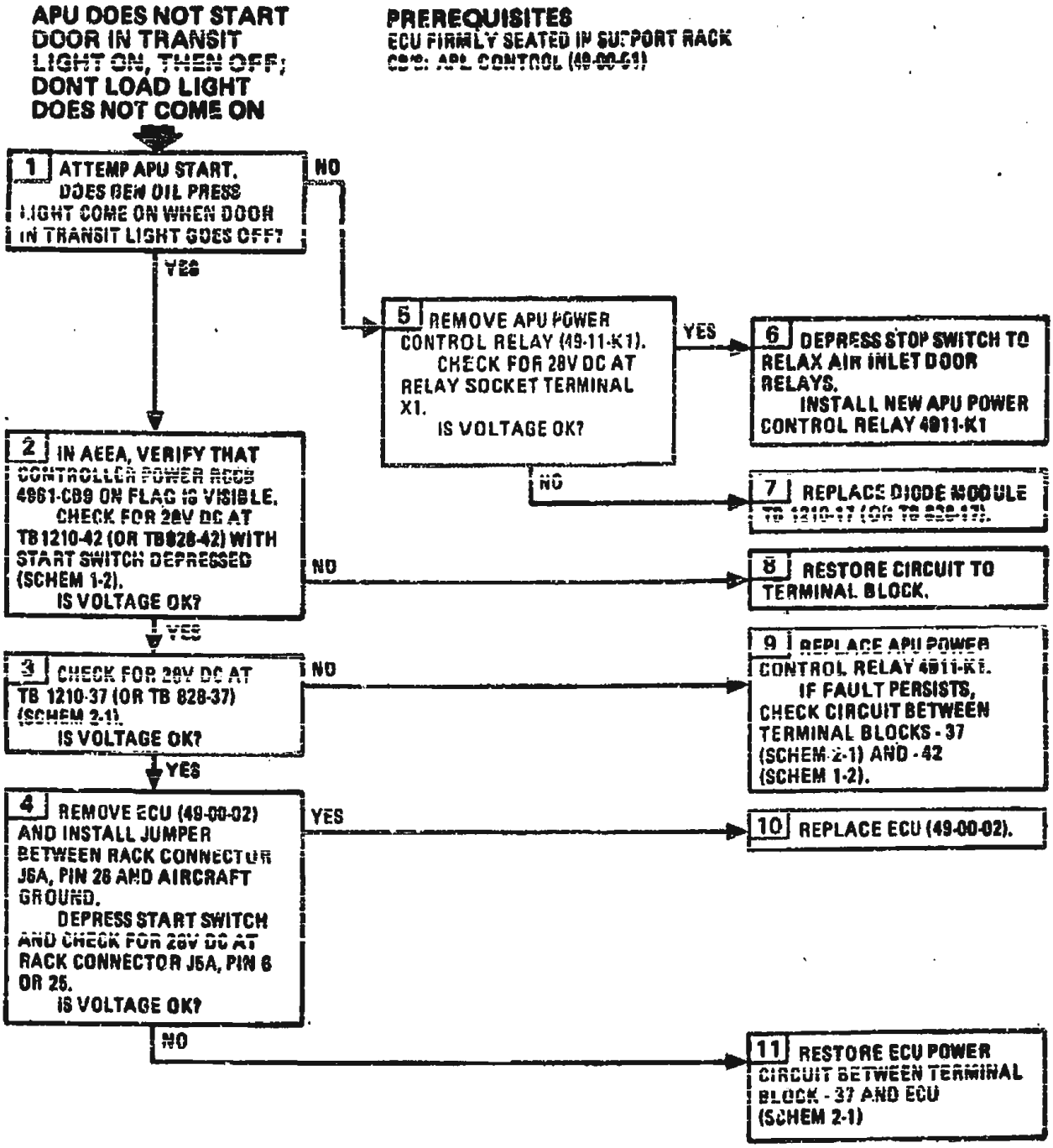
DONT LOAD LIGHT DOES NOT COME ON, APU STARTS AND RUNS

PREREQUISITES
FE/SO PANEL LIGHTS TEST OK
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: C83-88 THROUGH 817
C83-59 THROUGH 915
APU NOT RUNNING, APU MASTER POWER ON


1 IN FESC, PERFORM ILCB BITE CHECK.
IS BITE CHECK OK?
NO
4 REPLACE ILCB LOGIC CARD 1A7.
YES
2 IN MESC, REMOVE GEN FIELD TRIP TIME DELAY RELAY (2499-K15) FROM APU EQUIPMENT AND POWER CONTROL PANEL.
CHECK FOR CONTINUITY BETWEEN RELAY SOCKETS B2 AND X1.
IS CONTINUITY OK?
NO
5 RESTORE WIRING CONTINUITY BETWEEN 2499-K15 RELAY SOCKETS B2 AND X1.
YES
3 INSTALL JUMPER WIRE BETWEEN 2499-K15 RELAY SOCKETS B1 AND C1.
DOES DONT LOAD LIGHT COME ON?
YES
6 IN MESC, REPLACE GEN FIELD TRIP TIME DELAY RELAY (2499-K15).
NO
7 RESTORE WIRING CONTINUITY BETWEEN 2499-K15 RELAY SOCKETS B1 AND ILCB CONNECTOR 3317-P10 PIN 47 IN FESC.

M1-0003-49-419

DONT LOAD Light Does Not Come On, APU Starts and Runs
Figure 107

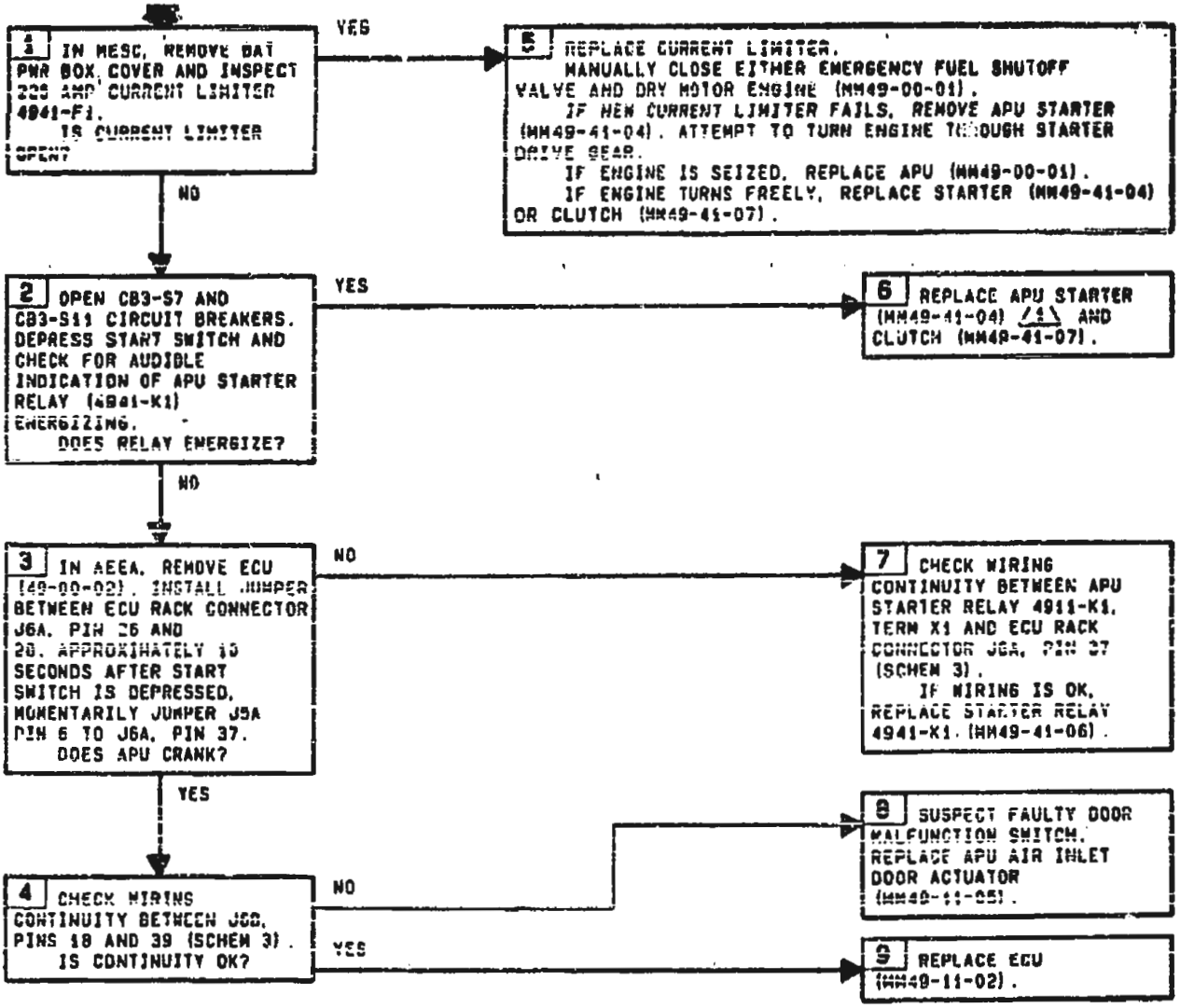

APU DOES NOT START
DOOR IN TRANSIT LIGHT ON, THEN OFF; DONT LOAD LIGHT DOES NOT COME ON
PREREQUISITES
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: APU CONTROL (49-00-01)
1 ATTEMP APU START. DOES GEN OIL PRESS LIGHT COME ON WHEN DOOR IN TRANSIT LIGHT GOES OFF?
NO
YES
2 IN AEEA, VERIFY THAT CONTROLLER POWER RCDS 4961-CB9 ON FLAG IS VISIBLE. CHECK FOR 28V DC AT TB1210-42 (OR TB828-42) WITH START SWITCH DEPRESSED (SCHEM 1-2). IS VOLTAGE OK?
NO
YES
3 CHECK FOR 28V DC AT TB 1210-37 (OR TB 828-37) (SCHEM 2-1). IS VOLTAGE OK?
NO
YES
4 REMOVE ECU (49-00-02) AND INSTALL JUMPER BETWEEN RACK CONNECTOR J6A, PIN 26 AND AIRCRAFT GROUND. DEPRESS START SWITCH AND CHECK FOR 28V DC AT RACK CONNECTOR J6A, PIN 6 OR 25. IS VOLTAGE OK?
NO
YES
5 REMOVE APU POWER CONTROL RELAY (49-11-K1). CHECK FOR 28V DC AT RELAY SOCKET TERMINAL X1. IS VOLTAGE OK?
YES
NO
6 DEPRESS STOP SWITCH TO RELAX AIR INLET DOOR RELAYS. INSTALL NEW APU POWER CONTROL RELAY 4911-K1
7 REPLACE DIODE MODULE TB 1210-37 (OR TB 828-37).
8 RESTORE CIRCUIT TO TERMINAL BLOCK.
9 REPLACE APU POWER CONTROL RELAY 4911-K1. IF FAULT PERSISTS, CHECK CIRCUIT BETWEEN TERMINAL BLOCKS - 37 (SCHEM 2-1) AND - 42 (SCHEM 1-2).
10 REPLACE ECU (49-00-02).
11 RESTORE ECU POWER CIRCUIT BETWEEN TERMINAL BLOCK - 37 AND ECU (SCHEM 2-1)

M1-0000-49-1082

APU Does Not Start. DOOR IN TRANSIT Light On, Then Off; DONT LOAD Light Does Not Come On
Figure 108

APU DOES NOT START, NO STARTER BATTERY CURRENT: DONT LOAD LIGHT ON

PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: APU CONTROL (MM49-00-01)
APU MASTER POWER ON


1 IN MESC, REMOVE BAT PWR BOX COVER AND INSPECT 225 AMP CURRENT LIMITER 4941-F1. IS CURRENT LIMITER OPEN?
YES
5 REPLACE CURRENT LIMITER. MANUALLY CLOSE EITHER EMERGENCY FUEL SHUTOFF VALVE AND DRY MOTOR ENGINE (MM49-00-01). IF NEW CURRENT LIMITER FAILS, REMOVE APU STARTER (MM49-41-04). ATTEMPT TO TURN ENGINE THROUGH STARTER DRIVE GEAR. IF ENGINE IS SEIZED, REPLACE APU (MM49-00-01). IF ENGINE TURNS FREELY, REPLACE STARTER (MM49-41-04) OR CLUTCH (MM49-41-07).
NO
2 OPEN CB3-S7 AND CB3-S11 CIRCUIT BREAKERS. DEPRESS START SWITCH AND CHECK FOR AUDIBLE INDICATION OF APU STARTER RELAY (4941-K1) ENERGIZING. DOES RELAY ENERGIZE?
YES
6 REPLACE APU STARTER (MM49-41-04) (1) AND CLUTCH (MM49-41-07).
NO
3 IN AEEA, REMOVE ECU (49-00-02). INSTALL JUMPER BETWEEN ECU RACK CONNECTOR J6A, PIN 26 AND 28. APPROXIMATELY 10 SECONDS AFTER START SWITCH IS DEPRESSED, MOMENTARILY JUMPER J6A PIN 6 TO J6A, PIN 37. DOES APU CRANK?
NO
7 CHECK WIRING CONTINUITY BETWEEN APU STARTER RELAY 4911-K1, TERM X1 AND ECU RACK CONNECTOR J6A, PIN 37 (SCHEM 3). IF WIRING IS OK, REPLACE STARTER RELAY 4941-K1. (MM49-41-06).
YES
4 CHECK WIRING CONTINUITY BETWEEN J6A, PINS 18 AND 39 (SCHEM 3). IS CONTINUITY OK?
NO
8 SUSPECT FAULTY DOOR MALFUNCTION SWITCH. REPLACE APU AIR INLET DOOR ACTUATOR (MM49-11-05).
YES
9 REPLACE ECU (MM49-11-02).

NOTE

(1) IT IS RECOMMENDED TO INSTALL A NEW CURRENT LIMITER WHENEVER THE APU STARTER IS REPLACED (49-41-04).

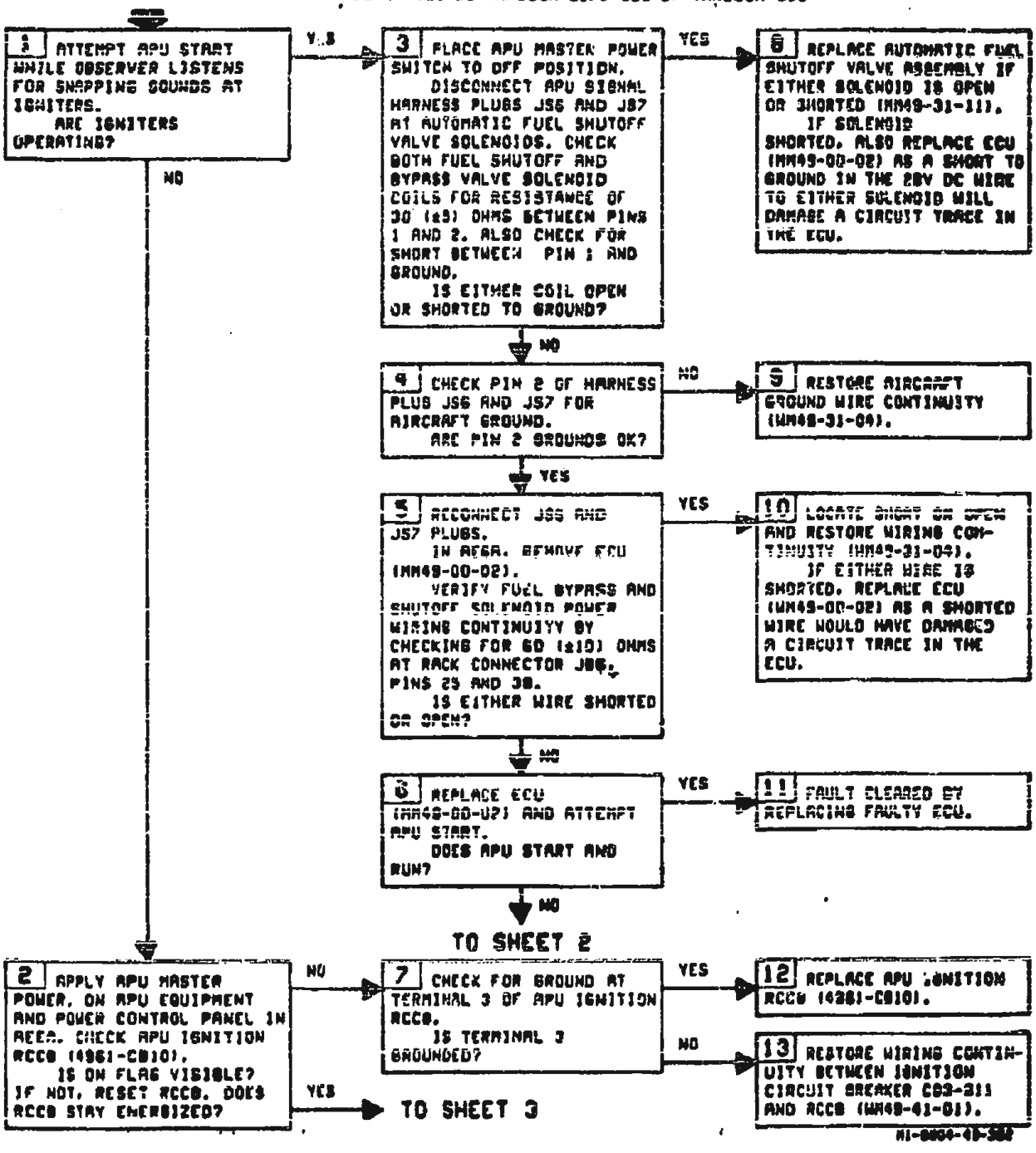
M1-8800-49-048

C APU Does Not Start. No Starter Battery Current;
C DONT LOAD Light On
C Figure 109

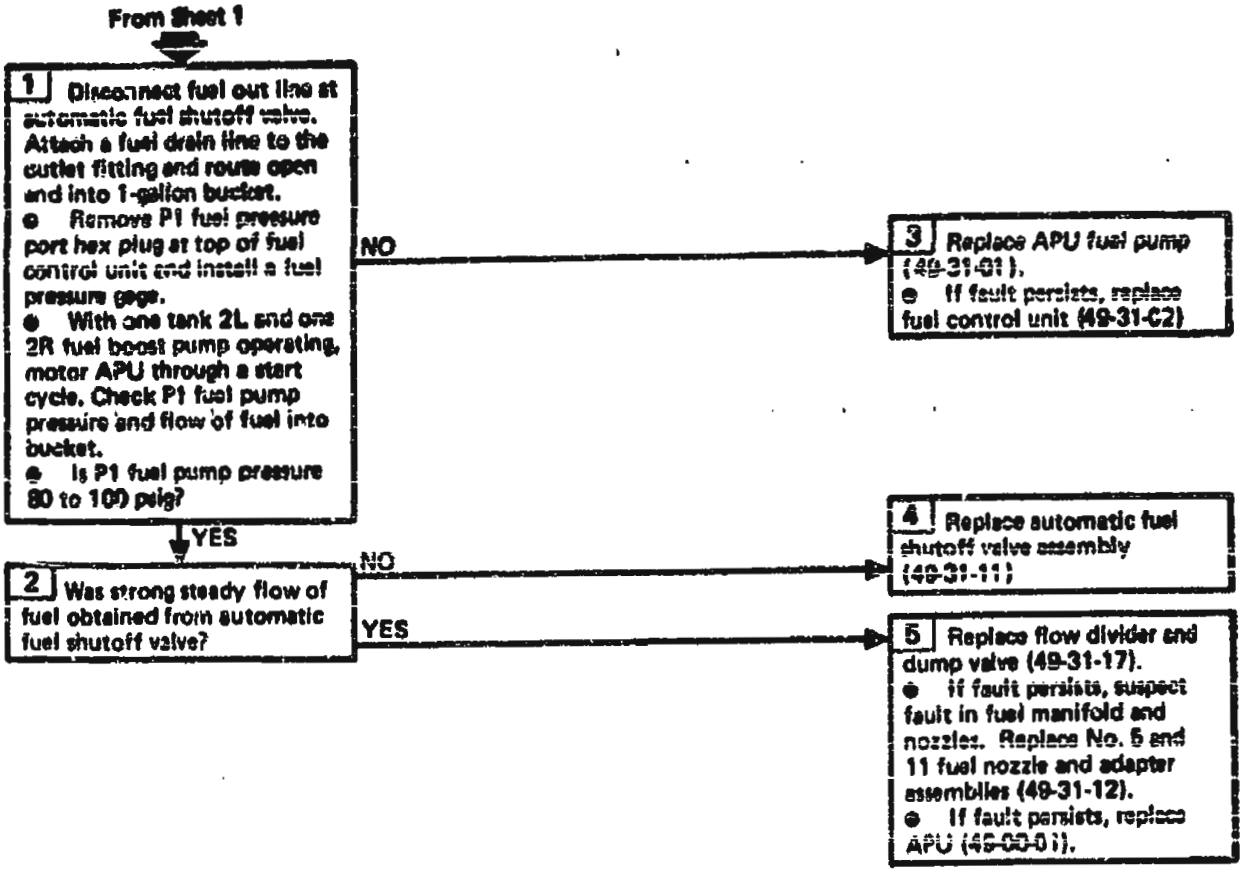
R EFFECTIVITY: ALL
R
002B

APU DOES NOT LIGHT OFF; HANGS AT 15% Ng. THEN SHUTS DOWN

PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK
APU PRIMARY AND SECONDARY FUEL SHUTOFF VALVES OPEN WHEN APU IS ROTORED FOR START
ENG 2 TANK VALVE OPEN
CB'S: CB3-CB THROUGH B:7, CB3-87 THROUGH B19

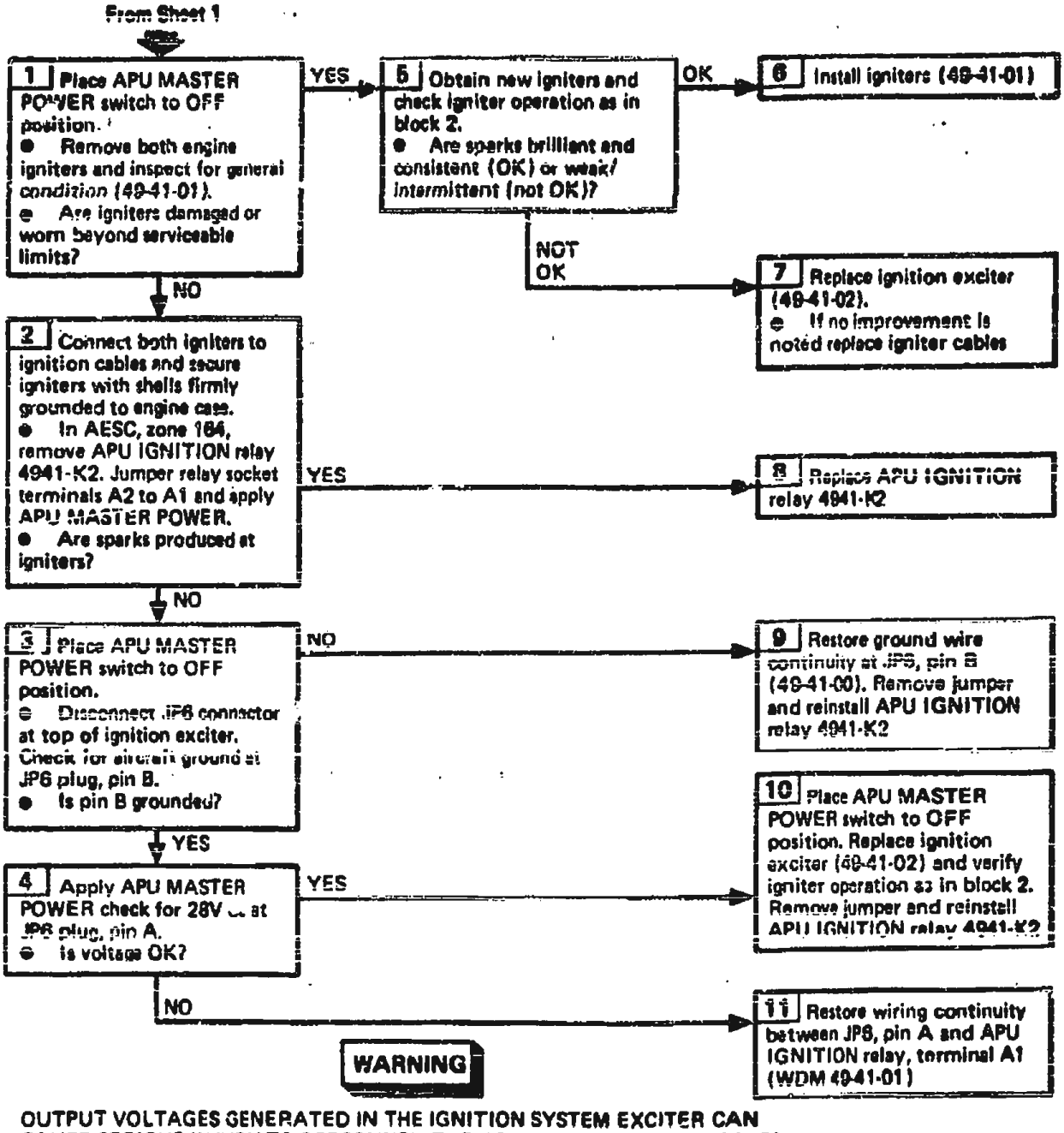

1 ATTEMPT APU START WHILE OBSERVER LISTENS FOR SNAPPING SOUNDS AT IGNITERS. ARE IGNITERS OPERATING?
YES
NO
3 PLACE APU MASTER POWER SWITCH TO OFF POSITION. DISCONNECT APU SIGNAL HARNESS PLUGS J56 AND J57 AT AUTOMATIC FUEL SHUTOFF VALVE SOLENOIDS. CHECK BOTH FUEL SHUTOFF AND BYPASS VALVE SOLENOID COILS FOR RESISTANCE OF 30 (±5) OHMS BETWEEN PINS 1 AND 2. ALSO CHECK FOR SHORT BETWEEN PIN 1 AND GROUND. IS EITHER COIL OPEN OR SHORTED TO GROUND?
YES
6 REPLACE AUTOMATIC FUEL SHUTOFF VALVE ASSEMBLY IF EITHER SOLENOID IS OPEN OR SHORTED (MM49-31-11). IF SOLENOID SHORTED, ALSO REPLACE ECU (MM49-00-02) AS A SHORT TO GROUND IN THE 28V DC WIRE TO EITHER SOLENOID WILL DAMAGE A CIRCUIT TRACE IN THE ECU.
NO
4 CHECK PIN 2 OF HARNESS PLUG J56 AND J57 FOR AIRCRAFT GROUND. ARE PIN 2 GROUNDS OK?
NO
5 RESTORE AIRCRAFT GROUND WIRE CONTINUITY (MM49-31-04).
YES
5 RECONNECT J56 AND J57 PLUGS. IN REAR, REMOVE ECU (MM49-00-02). VERIFY FUEL BYPASS AND SHUTOFF SOLENOID POWER WIRING CONTINUITY BY CHECKING FOR 60 (±10) OHMS AT RACK CONNECTOR J86, PINS 29 AND 38. IS EITHER WIRE SHORTED OR OPEN?
YES
10 LOCATE SHORT OR OPEN AND RESTORE WIRING CONTINUITY (MM49-31-04). IF EITHER WIRE IS SHORTED, REPLACE ECU (MM49-00-02) AS A SHORTED WIRE WOULD HAVE DAMAGED A CIRCUIT TRACE IN THE ECU.
NO
6 REPLACE ECU (MM49-00-02) AND ATTEMPT APU START. DOES APU START AND RUN?
YES
11 FAULT CLEARED BY REPLACING FAULTY ECU.
NO
TO SHEET 2
2 APPLY APU MASTER POWER, ON APU EQUIPMENT AND POWER CONTROL PANEL IN REAR. CHECK APU IGNITION RCCB (4361-CB10). IS ON FLAG VISIBLE? IF NOT, RESET RCCB. DOES RCCB STAY ENERGIZED?
NO
7 CHECK FOR GROUND AT TERMINAL 3 OF APU IGNITION RCCB. IS TERMINAL 3 GROUNDED?
YES
12 REPLACE APU IGNITION RCCB (4361-CB10).
NO
13 RESTORE WIRING CONTINUITY BETWEEN IGNITION CIRCUIT BREAKER CB3-311 AND RCCB (MM49-41-01).
YES
TO SHEET 3

APU Does Not Light Off - Hangs at 15-18% Ng, Then Shuts Down
Figure 110 (Sheet 1)

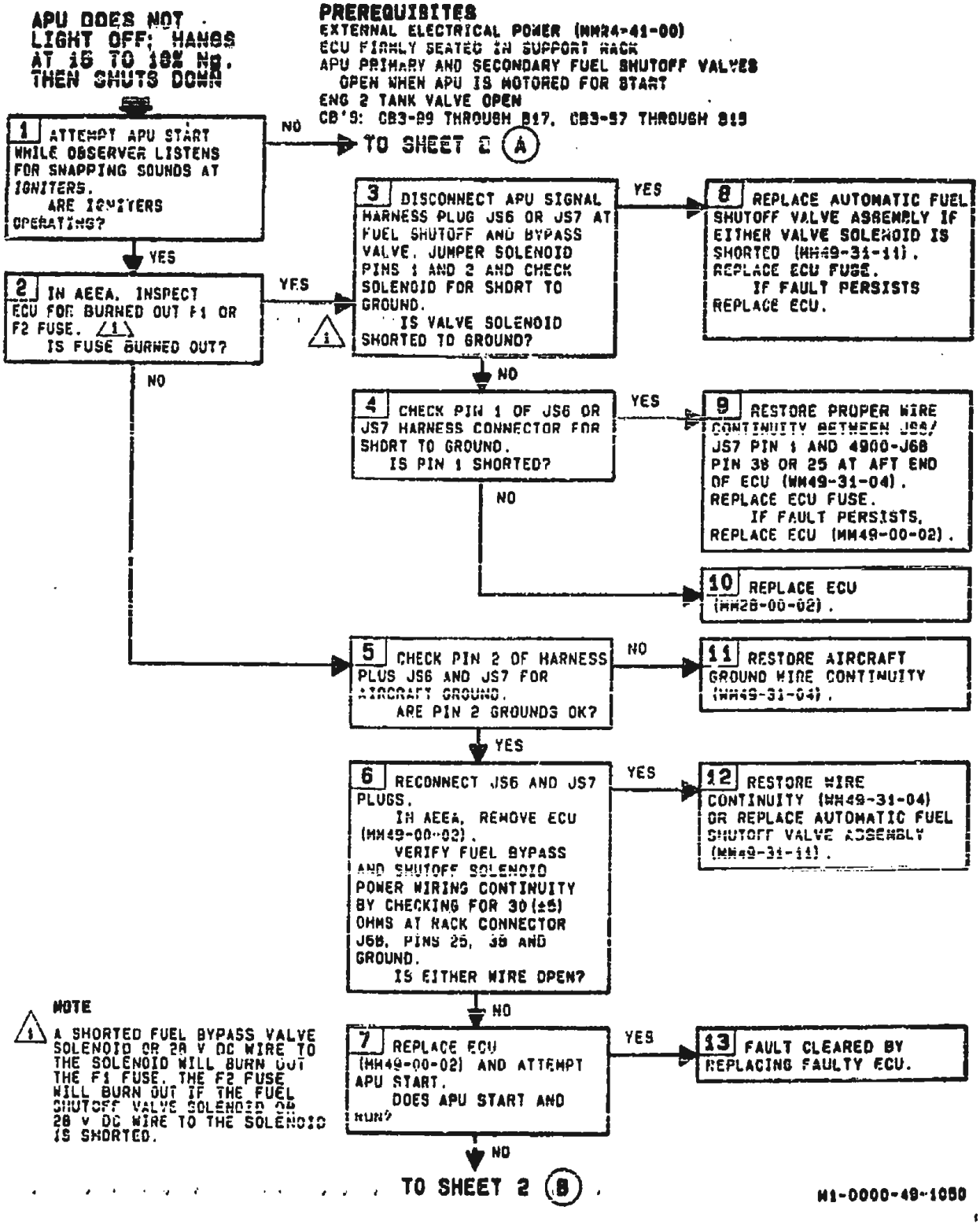

From Sheet 1
1 Disconnect fuel out line at automatic fuel shutoff valve. Attach a fuel drain line to the outlet fitting and route open end into 1-gallon bucket.
● Remove P1 fuel pressure port hex plug at top of fuel control unit and install a fuel pressure gage.
● With one tank 2L and one 2R fuel boost pump operating, motor APU through a start cycle. Check P1 fuel pump pressure and flow of fuel into bucket.
● Is P1 fuel pump pressure 80 to 100 psig?
NO
3 Replace APU fuel pump (49-31-01).
● If fault persists, replace fuel control unit (49-31-02)
YES
2 Was strong steady flow of fuel obtained from automatic fuel shutoff valve?
NO
4 Replace automatic fuel shutoff valve assembly (49-31-11)
YES
5 Replace flow divider and dump valve (49-31-17).
● If fault persists, suspect fault in fuel manifold and nozzles. Replace No. 5 and 11 fuel nozzle and adapter assemblies (49-31-12).
● If fault persists, replace APU (49-00-01).

M1-B102-49-997

APU Does Not Light Off - Hangs at 15-18% Ng, Then Shuts Down
Figure 110 (Sheet 2)

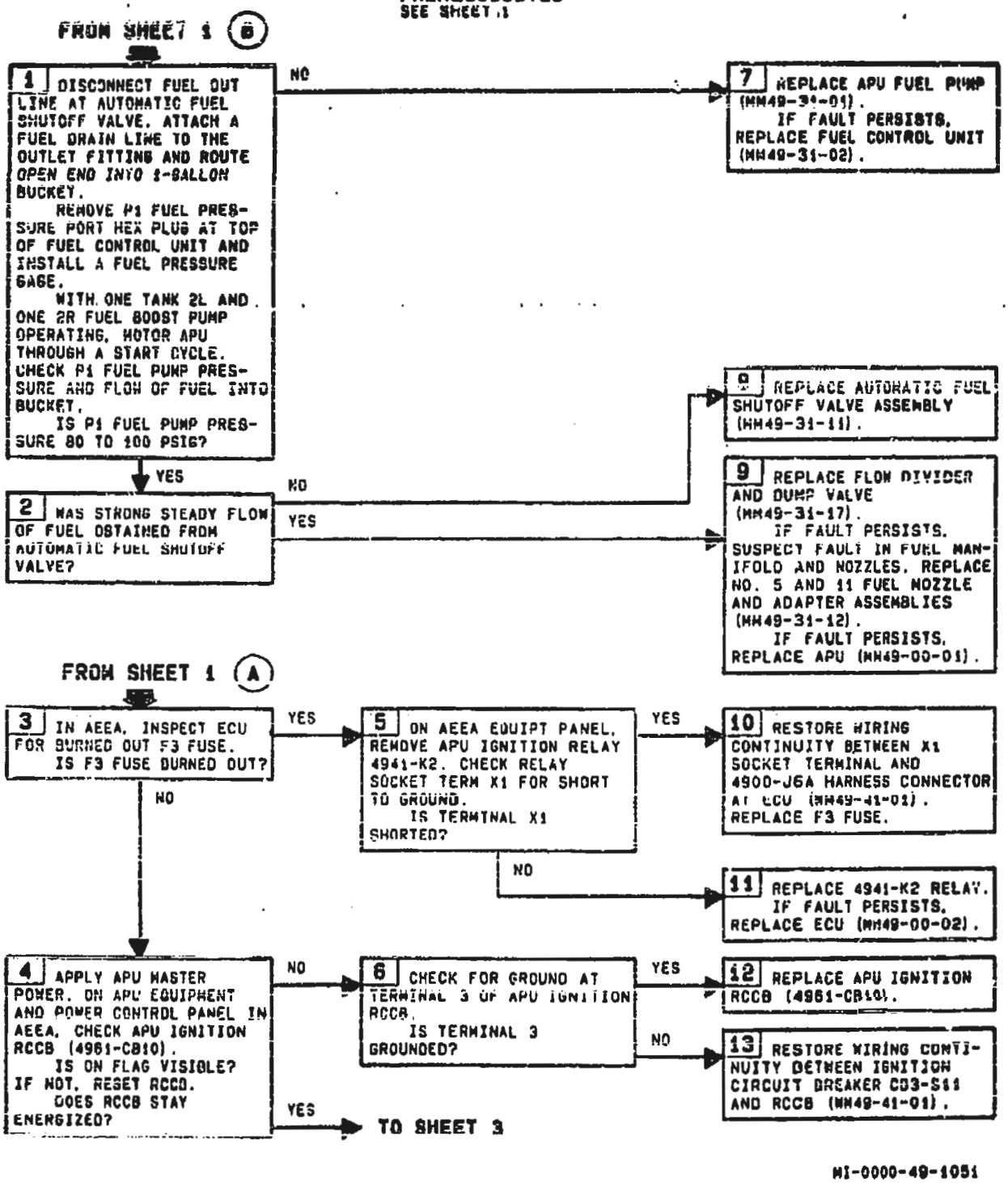

From Sheet 1
1 Place APU MASTER POWER switch to OFF position.
● Remove both engine igniters and inspect for general condition (49-41-01).
● Are igniters damaged or worn beyond serviceable limits?
YES
5 Obtain new igniters and check igniter operation as in block 2.
● Are sparks brilliant and consistent (OK) or weak/ intermittent (not OK)?
OK
6 Install igniters (49-41-01)
NOT OK
7 Replace ignition exciter (49-41-02).
● If no improvement is noted replace igniter cables
NO
2 Connect both igniters to ignition cables and secure igniters with shells firmly grounded to engine case.
● In AESC, zone 184, remove APU IGNITION relay 4941-K2. Jumper relay socket terminals A2 to A1 and apply APU MASTER POWER.
● Are sparks produced at igniters?
YES
8 Replace APU IGNITION relay 4941-K2
NO
3 Place APU MASTER POWER switch to OFF position.
● Disconnect JP6 connector at top of ignition exciter. Check for aircraft ground at JP6 plug, pin B.
● Is pin B grounded?
NO
9 Restore ground wire continuity at JP6, pin B (49-41-00). Remove jumper and reinstall APU IGNITION relay 4941-K2
YES
4 Apply APU MASTER POWER check for 28V ⎓ at JP6 plug, pin A.
● Is voltage OK?
YES
10 Place APU MASTER POWER switch to OFF position. Replace ignition exciter (49-41-02) and verify igniter operation as in block 2. Remove jumper and reinstall APU IGNITION relay 4941-K2
NO
11 Restore wiring continuity between JP6, pin A and APU IGNITION relay, terminal A1 (WDM 49-41-01)
WARNING
OUTPUT VOLTAGES GENERATED IN THE IGNITION SYSTEM EXCITER CAN CAUSE SERIOUS INJURY TO PERSONNEL. THE APU BAT BUS IGNITION (CB3) CIRCUIT BREAKER SHOULD BE OPENED AND THE APU IGNITION RCCB (CB10) SHOULD BE MANUALLY TRIPPED TO ASSURE REMOVAL OF POWER FROM THE EXCITER. ALWAYS WAIT SEVERAL MINUTES FOR VOLTAGES IN THE EXCITER TO BLEED DOWN BEFORE WORKING ON THE HIGH TENSION PORTION OF THE IGNITION SYSTEM. ALWAYS DISCONNECT AND GROUND OUT THE HIGH TENSION HARNESS AT THE IGNITER BEFORE REMOVING THE EXCITER OR IGNITER.
M1-0003-49-353

APU Does Not Light Off - Hangs at 15-18% Ng, Then Shuts Down
Figure 110 (Sheet 3)


APU DOES NOT LIGHT OFF; HANGS AT 15 TO 18% Ng. THEN SHUTS DOWN
PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK
APU PRIMARY AND SECONDARY FUEL SHUTOFF VALVES OPEN WHEN APU IS MOTORED FOR START
ENG 2 TANK VALVE OPEN
CB'S: CB3-89 THROUGH B17, CB3-97 THROUGH B19
1 ATTEMPT APU START WHILE OBSERVER LISTENS FOR SNAPPING SOUNDS AT IGNITERS. ARE IGNITERS OPERATING?
NO
TO SHEET 2 (A)
YES
2 IN AEEA, INSPECT ECU FOR BURNED OUT F1 OR F2 FUSE. (1) IS FUSE BURNED OUT?
YES
3 DISCONNECT APU SIGNAL HARNESS PLUG JS6 OR JS7 AT FUEL SHUTOFF AND BYPASS VALVE. JUMPER SOLENOID PINS 1 AND 2 AND CHECK SOLENOID FOR SHORT TO GROUND. IS VALVE SOLENOID SHORTED TO GROUND?
(1)
YES
8 REPLACE AUTOMATIC FUEL SHUTOFF VALVE ASSEMBLY IF EITHER VALVE SOLENOID IS SHORTED (MM49-31-11). REPLACE ECU FUSE. IF FAULT PERSISTS REPLACE ECU.
NO
NO
4 CHECK PIN 1 OF JS6 OR JS7 HARNESS CONNECTOR FOR SHORT TO GROUND. IS PIN 1 SHORTED?
YES
9 RESTORE PROPER WIRE CONTINUITY BETWEEN JS6/JS7 PIN 1 AND 4900-J68 PIN 38 OR 25 AT AFT END OF ECU (MM49-31-04). REPLACE ECU FUSE. IF FAULT PERSISTS, REPLACE ECU (MM49-00-02).
NO
10 REPLACE ECU (MM28-00-02).
5 CHECK PIN 2 OF HARNESS PLUS JS6 AND JS7 FOR AIRCRAFT GROUND. ARE PIN 2 GROUNDS OK?
NO
11 RESTORE AIRCRAFT GROUND WIRE CONTINUITY (MM49-31-04).
YES
6 RECONNECT JS6 AND JS7 PLUGS. IN AEEA, REMOVE ECU (MM49-00-02). VERIFY FUEL BYPASS AND SHUTOFF SOLENOID POWER WIRING CONTINUITY BY CHECKING FOR 30 (±5) OHMS AT RACK CONNECTOR J68, PINS 25, 38 AND GROUND. IS EITHER WIRE OPEN?
YES
12 RESTORE WIRE CONTINUITY (MM49-31-04) OR REPLACE AUTOMATIC FUEL SHUTOFF VALVE ASSEMBLY (MM49-31-11).
NO
NOTE
(1) A SHORTED FUEL BYPASS VALVE SOLENOID OR 28 V DC WIRE TO THE SOLENOID WILL BURN OUT THE F1 FUSE. THE F2 FUSE WILL BURN OUT IF THE FUEL SHUTOFF VALVE SOLENOID OR 28 V DC WIRE TO THE SOLENOID IS SHORTED.
7 REPLACE ECU (MM49-00-02) AND ATTEMPT APU START. DOES APU START AND RUN?
YES
13 FAULT CLEARED BY REPLACING FAULTY ECU.
NO
TO SHEET 2 (B)
M1-0000-49-1050

APU Does Not Light Off - Hangs at 15-18% Ng, Then Shuts Down
Figure 110 (Sheet 1)

PREREQUISITES
SEE SHEET 1


FROM SHEET 1 (B)
1 DISCONNECT FUEL OUT LINE AT AUTOMATIC FUEL SHUTOFF VALVE. ATTACH A FUEL DRAIN LINE TO THE OUTLET FITTING AND ROUTE OPEN END INTO 1-GALLON BUCKET.
REMOVE P1 FUEL PRESSURE PORT HEX PLUG AT TOP OF FUEL CONTROL UNIT AND INSTALL A FUEL PRESSURE GAGE.
WITH ONE TANK 2L AND ONE 2R FUEL BOOST PUMP OPERATING, MOTOR APU THROUGH A START CYCLE. CHECK P1 FUEL PUMP PRESSURE AND FLOW OF FUEL INTO BUCKET.
IS P1 FUEL PUMP PRESSURE 80 TO 100 PSIG?
NO
7 REPLACE APU FUEL PUMP (MM49-31-01).
IF FAULT PERSISTS, REPLACE FUEL CONTROL UNIT (MM49-31-02).
YES
2 WAS STRONG STEADY FLOW OF FUEL OBTAINED FROM AUTOMATIC FUEL SHUTOFF VALVE?
NO
8 REPLACE AUTOMATIC FUEL SHUTOFF VALVE ASSEMBLY (MM49-31-11).
YES
9 REPLACE FLOW DIVIDER AND DUMP VALVE (MM49-31-17).
IF FAULT PERSISTS, SUSPECT FAULT IN FUEL MANIFOLD AND NOZZLES. REPLACE NO. 5 AND 11 FUEL NOZZLE AND ADAPTER ASSEMBLIES (MM49-31-12).
IF FAULT PERSISTS, REPLACE APU (MM49-00-01).
FROM SHEET 1 (A)
3 IN AEEA, INSPECT ECU FOR BURNED OUT F3 FUSE.
IS F3 FUSE BURNED OUT?
YES
5 ON AEEA EQUIPT PANEL, REMOVE APU IGNITION RELAY 4941-K2. CHECK RELAY SOCKET TERM X1 FOR SHORT TO GROUND.
IS TERMINAL X1 SHORTED?
YES
10 RESTORE WIRING CONTINUITY BETWEEN X1 SOCKET TERMINAL AND 4900-J6A HARNESS CONNECTOR AT ECU (MM49-41-01). REPLACE F3 FUSE.
NO
11 REPLACE 4941-K2 RELAY.
IF FAULT PERSISTS, REPLACE ECU (MM49-00-02).
NO
4 APPLY APU MASTER POWER. ON APU EQUIPMENT AND POWER CONTROL PANEL IN AEEA, CHECK APU IGNITION RCCB (4961-CB10).
IS ON FLAG VISIBLE? IF NOT, RESET RCCB.
DOES RCCB STAY ENERGIZED?
NO
6 CHECK FOR GROUND AT TERMINAL 3 OF APU IGNITION RCCB.
IS TERMINAL 3 GROUNDED?
YES
12 REPLACE APU IGNITION RCCB (4961-CB10).
NO
13 RESTORE WIRING CONTINUITY BETWEEN IGNITION CIRCUIT BREAKER CB3-S11 AND RCCB (MM49-41-01).
YES
TO SHEET 3

MI-0000-49-1051

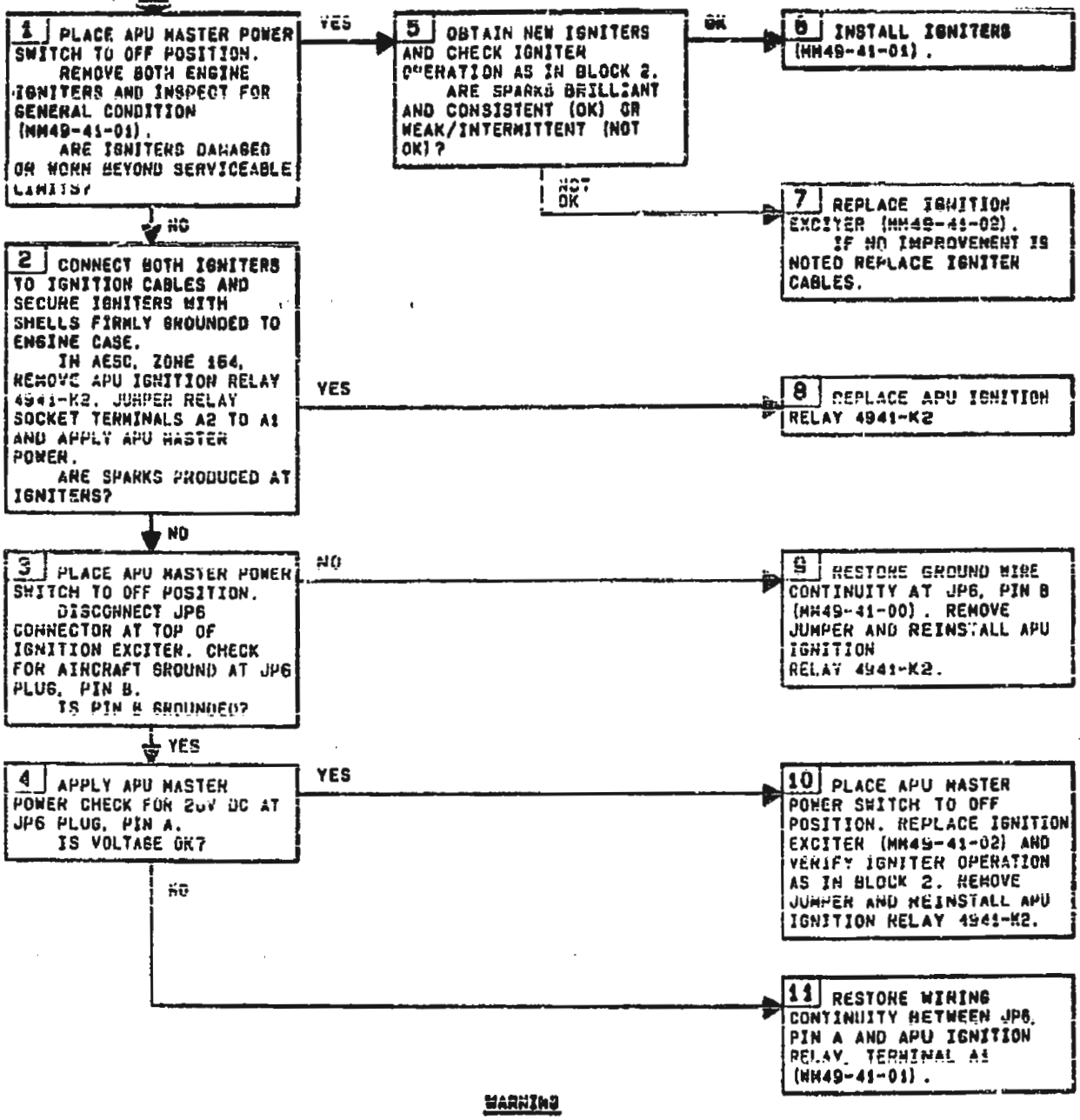
APU Does Not Light Off - Hangs at 15-18% Ng, Then Shuts Down
Figure 110 (Sheet 2)

R
R
0028

EFFECTIVITY: AIRCRAFT HAVING ECU WITH HAM STD SB49-158 FUSES

FROM SHEET 2

PREREQUISITES
SEE SHEET 1

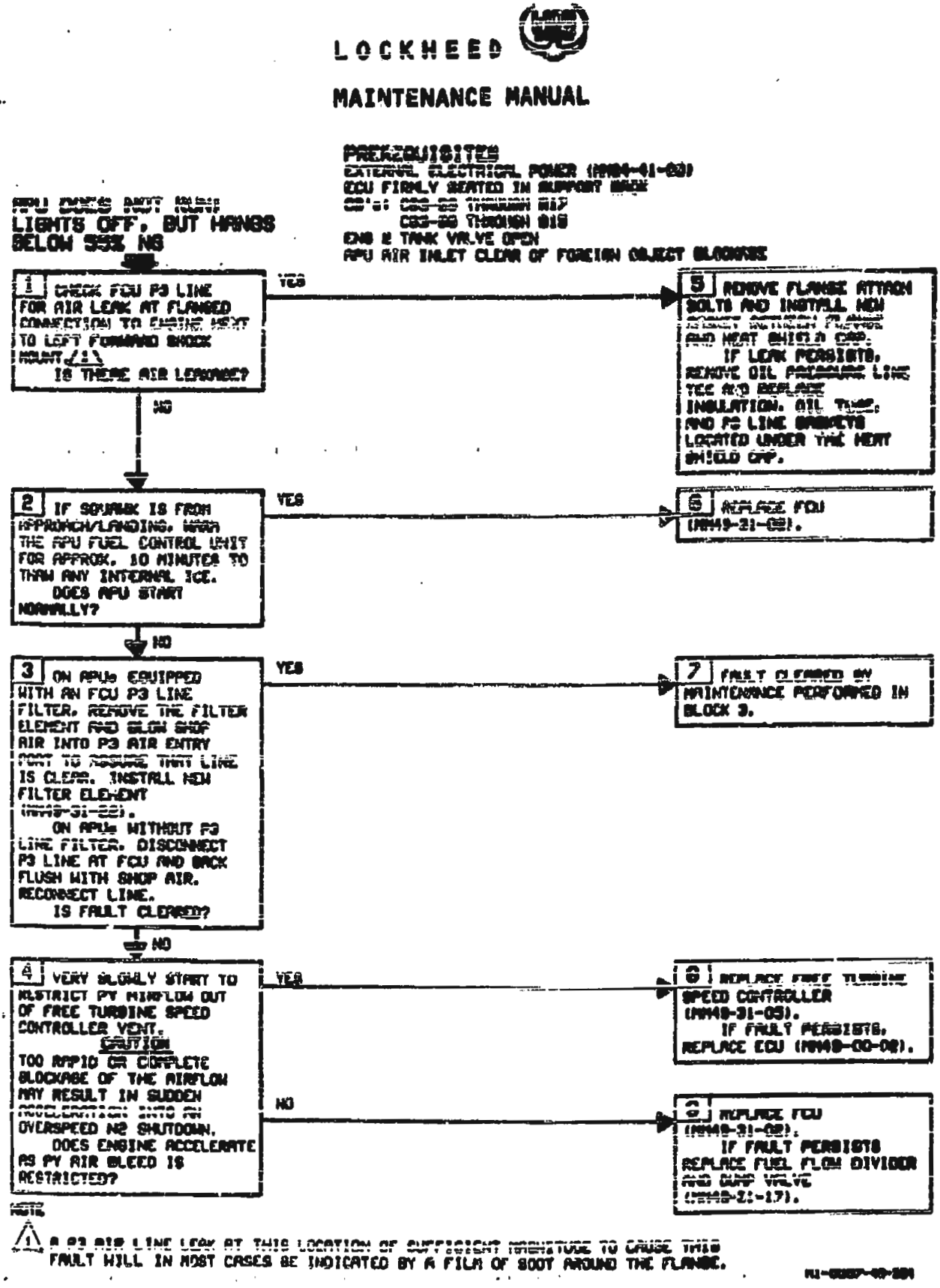

1 PLACE APU MASTER POWER SWITCH TO OFF POSITION. REMOVE BOTH ENGINE IGNITERS AND INSPECT FOR GENERAL CONDITION (MM49-41-01). ARE IGNITERS DAMAGED OR WORN BEYOND SERVICEABLE LIMITS?
YES
5 OBTAIN NEW IGNITERS AND CHECK IGNITER OPERATION AS IN BLOCK 2. ARE SPARKS BRILLIANT AND CONSISTENT (OK) OR WEAK/INTERMITTENT (NOT OK)?
OK
6 INSTALL IGNITERS (MM49-41-01).
NOT OK
7 REPLACE IGNITION EXCITER (MM49-41-02). IF NO IMPROVEMENT IS NOTED REPLACE IGNITER CABLES.
NO
2 CONNECT BOTH IGNITERS TO IGNITION CABLES AND SECURE IGNITERS WITH SHELLS FIRMLY GROUNDED TO ENGINE CASE. IN AESC, ZONE 164, REMOVE APU IGNITION RELAY 4941-K2. JUMPER RELAY SOCKET TERMINALS A2 TO A1 AND APPLY APU MASTER POWER. ARE SPARKS PRODUCED AT IGNITERS?
YES
8 REPLACE APU IGNITION RELAY 4941-K2
NO
3 PLACE APU MASTER POWER SWITCH TO OFF POSITION. DISCONNECT JP6 CONNECTOR AT TOP OF IGNITION EXCITER. CHECK FOR AIRCRAFT GROUND AT JP6 PLUG, PIN B. IS PIN B GROUNDED?
NO
9 RESTORE GROUND WIRE CONTINUITY AT JP6, PIN B (MM49-41-00). REMOVE JUMPER AND REINSTALL APU IGNITION RELAY 4941-K2.
YES
4 APPLY APU MASTER POWER CHECK FOR 28V DC AT JP6 PLUG, PIN A. IS VOLTAGE OK?
YES
10 PLACE APU MASTER POWER SWITCH TO OFF POSITION. REPLACE IGNITION EXCITER (MM49-41-02) AND VERIFY IGNITER OPERATION AS IN BLOCK 2. REMOVE JUMPER AND REINSTALL APU IGNITION RELAY 4941-K2.
NO
11 RESTORE WIRING CONTINUITY BETWEEN JP6, PIN A AND APU IGNITION RELAY, TERMINAL A1 (MM49-41-01).

WARNING

OUTPUT VOLTAGES GENERATED IN THE IGNITION SYSTEM EXCITER CAN CAUSE SERIOUS INJURY TO PERSONNEL. THE APU BAT BUS IGNITION (CB3) CIRCUIT BREAKER SHOULD BE OPENED AND THE APU IGNITION RCCB (CB10) SHOULD BE MANUALLY TRIPPED TO ASSURE REMOVAL OF POWER FROM THE EXCITER. ALWAYS WAIT SEVERAL MINUTES FOR VOLTAGES IN THE EXCITER TO BLEED DOWN BEFORE WORKING ON THE HIGH TENSION PORTION OF THE IGNITION SYSTEM. ALWAYS DISCONNECT AND GROUND OUT THE HIGH TENSION HARNESS AT THE IGNITER BEFORE REMOVING THE EXCITER OR IGNITER.

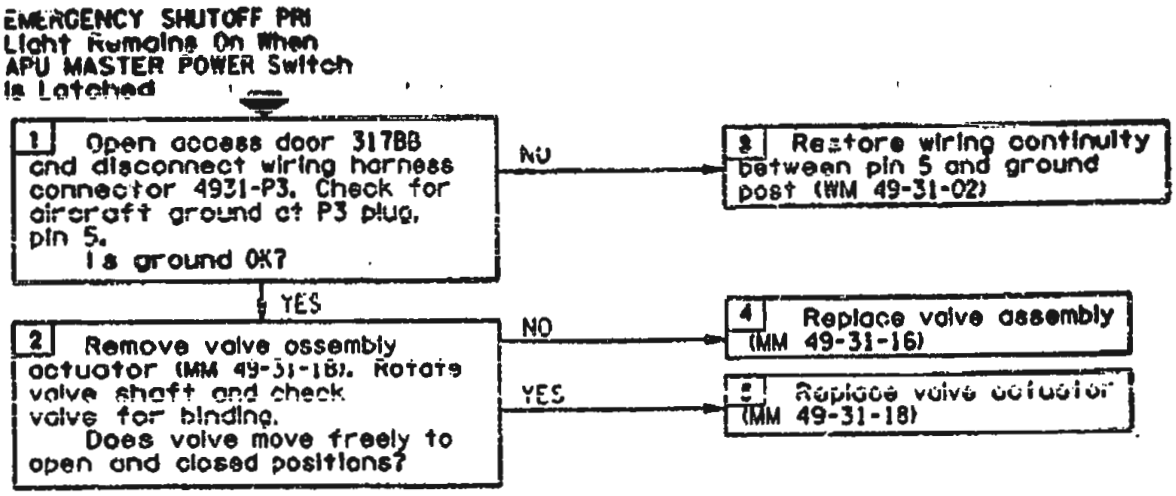
M1-0000-49-1052

APU Does Not Light Off - Hangs at 15-18% Ng, Then Shuts Down
Figure 110 (Sheet 3)


PREREQUISITES
EXTERNAL ELECTRICAL POWER (49-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK
CB's: C03-33 THROUGH B17
C03-33 THROUGH B18
END E TANK VALVE OPEN
APU AIR INLET CLEAR OF FOREIGN OBJECT BLOCKAGE
APU ENTERS DRY MOTOR
LIGHTS OFF, BUT HANGS
BELOW 55% NG
1 CHECK FCU P3 LINE FOR AIR LEAK AT FLANGED CONNECTION TO ENGINE MOUNT TO LEFT FORWARD SHOCK MOUNT. (1)
IS THERE AIR LEAKAGE?
YES
5 REMOVE FLANGE ATTACH BOLTS AND INSTALL NEW
AND HEAT SHIELD CAP.
IF LEAK PERSISTS,
REMOVE OIL PRESSURE LINE
INSULATION, OIL TANK,
AND P3 LINE BRACKETS
LOCATED UNDER THE HEAT
SHIELD CAP.
NO
2 IF SQUAWK IS FROM APPROACH/LANDING, WARM THE APU FUEL CONTROL UNIT FOR APPROX. 10 MINUTES TO THAW ANY INTERNAL ICE.
DOES APU START NORMALLY?
YES
6 REPLACE FCU (49-21-02).
NO
3 ON APUs EQUIPPED WITH AN FCU P3 LINE FILTER, REMOVE THE FILTER ELEMENT AND BLOW SHOP AIR INTO P3 AIR ENTRY PORT TO ASSURE THAT LINE IS CLEAR. INSTALL NEW FILTER ELEMENT (49-31-22).
ON APUs WITHOUT P3 LINE FILTER, DISCONNECT P3 LINE AT FCU AND BACK FLUSH WITH SHOP AIR. RECONNECT LINE.
IS FAULT CLEARED?
YES
7 FAULT CLEARED BY MAINTENANCE PERFORMED IN BLOCK 3.
NO
4 VERY SLOWLY START TO RESTRICT PY AIRFLOW OUT OF FREE TURBINE SPEED CONTROLLER VENT.
CAUTION
TOO RAPID OR COMPLETE BLOCKAGE OF THE AIRFLOW MAY RESULT IN SUDDEN ACCELERATION INTO AN OVERSPEED N2 SHUTDOWN.
DOES ENGINE ACCELERATE AS PY AIR BLEED IS RESTRICTED?
YES
8 REPLACE FREE TURBINE SPEED CONTROLLER (49-31-03).
IF FAULT PERSISTS,
REPLACE ECU (49-00-00).
NO
9 REPLACE FCU (49-21-02).
IF FAULT PERSISTS
REPLACE FUEL FLOW DIVIDER AND DUMP VALVE (49-21-17).
NOTE:
1 A P3 AIR LINE LEAK AT THIS LOCATION OF SUFFICIENT MAGNITUDE TO CAUSE THIS FAULT WILL IN MOST CASES BE INDICATED BY A FILM OF SOOT AROUND THE FLANGE.

APU Does Not Run; Lights Off, But Hangs Below 55% Ng
Figure 111

PREREQUISITES
CB's: CB3-B9 through B-17


EMERGENCY SHUTOFF PRI Light Remains On When APU MASTER POWER Switch is Latched
1 Open access door 317BB and disconnect wiring harness connector 4931-P3. Check for aircraft ground at P3 plug, pin 5. Is ground OK?
NO
3 Restore wiring continuity between pin 5 and ground post (MM 49-31-02)
YES
2 Remove valve assembly actuator (MM 49-31-18). Rotate valve shaft and check valve for binding. Does valve move freely to open and closed positions?
NO
4 Replace valve assembly (MM 49-31-16)
YES
5 Replace valve actuator (MM 49-31-18)

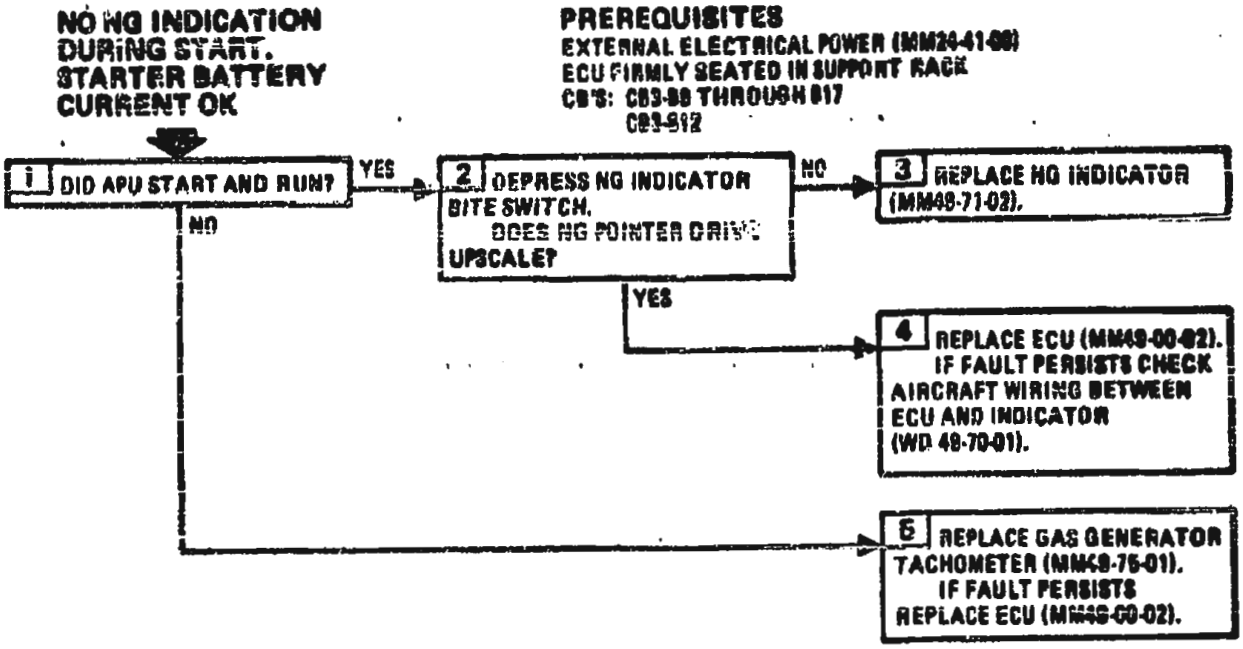
NOTE

The APU EMERGENCY SHUTOFF PRI light on the FE/SO FUEL SYSTEM panel normally blinks on, then off, when APU master power is applied to indicate opening of the APU primary fuel shutoff valve. This indication does not appear if the valve was manually actuated and left in the open position or the APU was the only source of electrical power and dc gnd svce bus power required to close the valve was removed when the APU was shutdown.
A constant PRI light indicates that the valve is closed, but is not responding to the open command input signal.

Possible Faults:
1 The primary fuel shutoff valve is jammed in the closed position or a malfunction in the valve assembly gear train inhibits valve opening.
2 Inoperative valve actuator

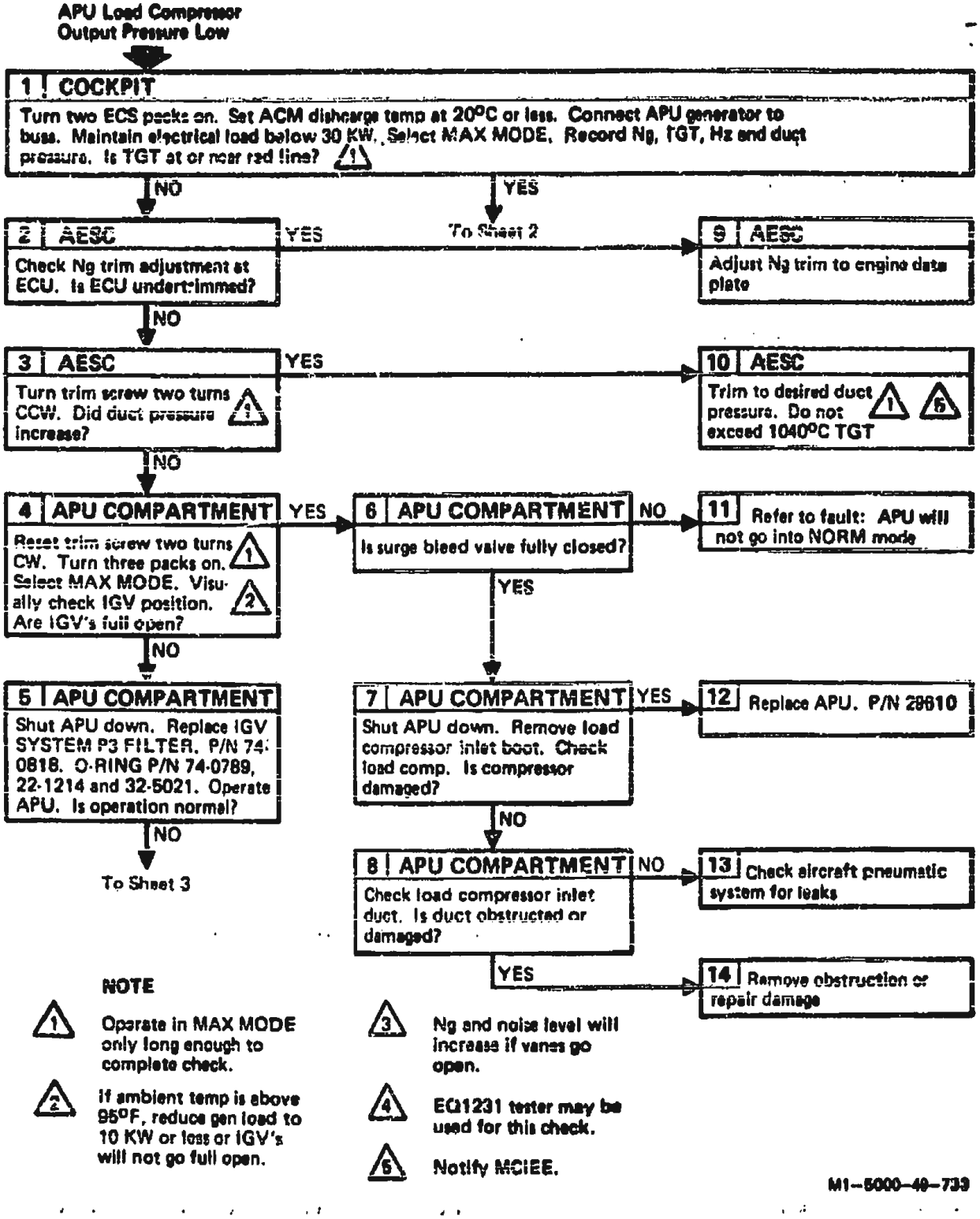
MI-0003-49-212

R EMERGENCY SHUTOFF PRI Light Remains On When APU MASTER POWER
R Switch is Latched
R Figure 112

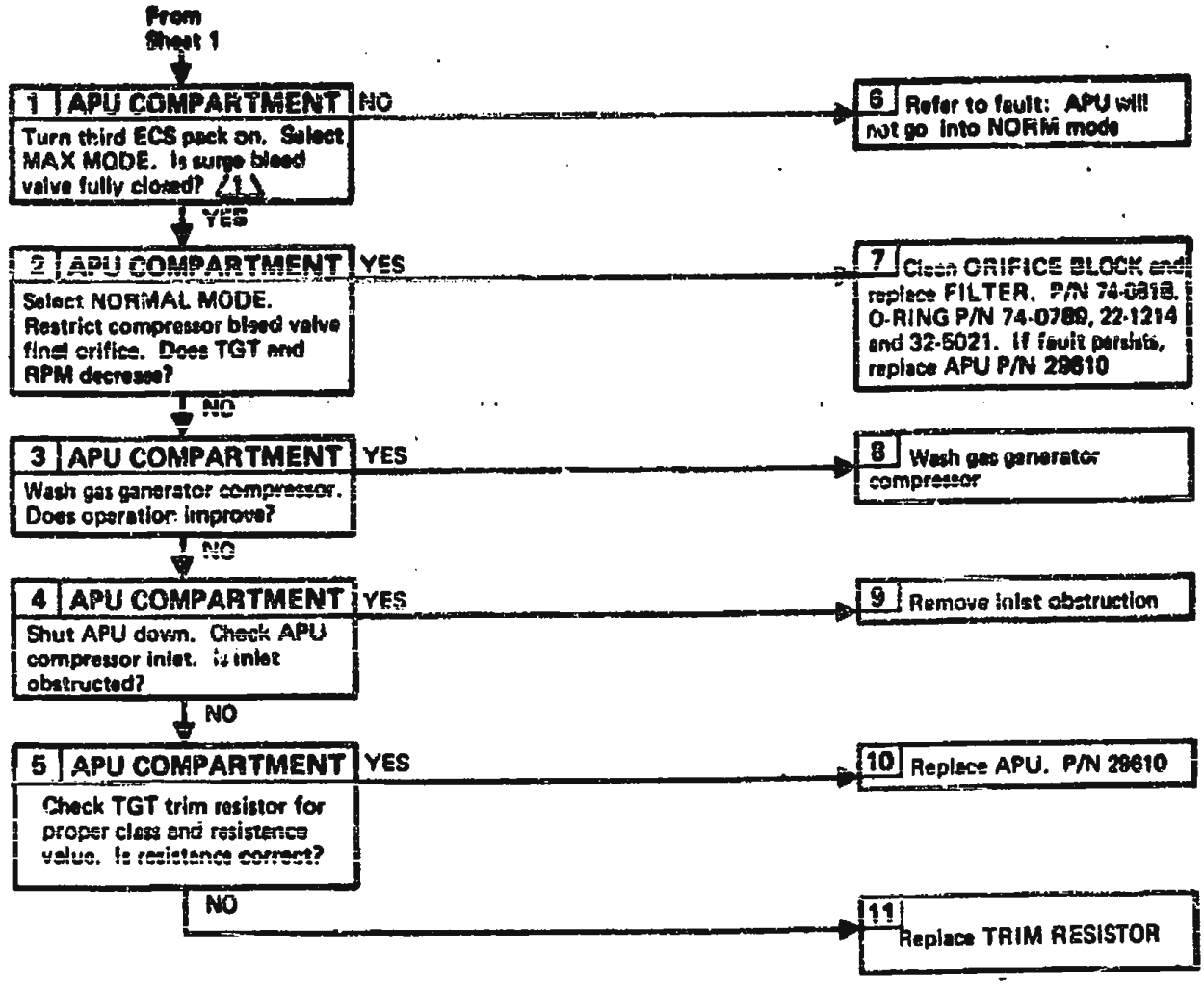

NO NG INDICATION DURING START. STARTER BATTERY CURRENT OK
PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: CB3-88 THROUGH 817
CB3-912
1 DID APU START AND RUN?
YES
NO
2 DEPRESS NG INDICATOR BITE SWITCH. DOES NG POINTER DRIVE UPSCALE?
NO
3 REPLACE NG INDICATOR (MM49-71-02).
YES
4 REPLACE ECU (MM49-00-02). IF FAULT PERSISTS CHECK AIRCRAFT WIRING BETWEEN ECU AND INDICATOR (WD 49-70-01).
5 REPLACE GAS GENERATOR TACHOMETER (MM49-75-01). IF FAULT PERSISTS REPLACE ECU (MM49-00-02).

M1-0104-49-407

No Ng Indication During Start, Starter Battery Current OK
Figure 113

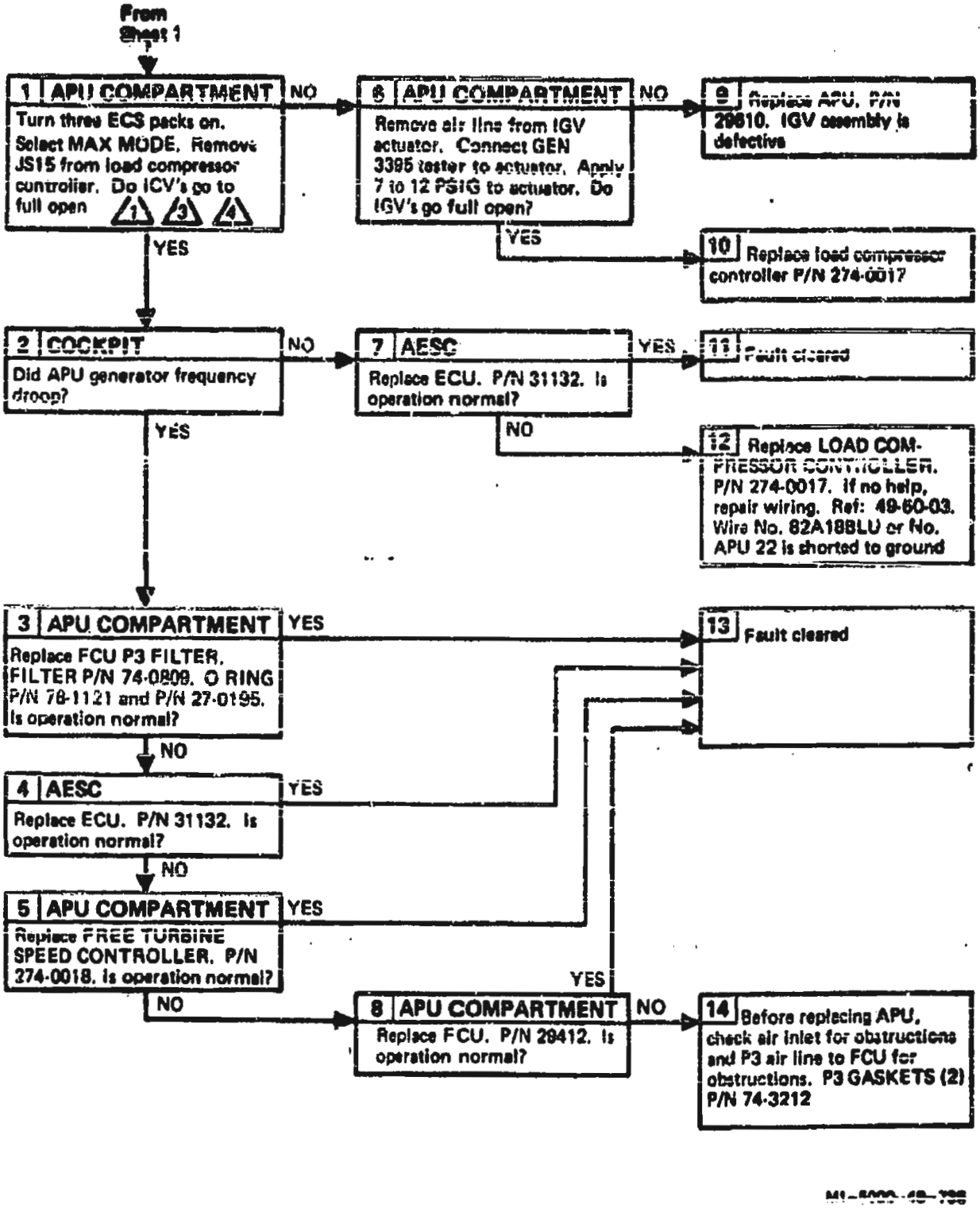

APU Load Compressor Output Pressure Low
1 COCKPIT
Turn two ECS packs on. Set ACM discharge temp at 20°C or less. Connect APU generator to buss. Maintain electrical load below 30 KW. Select MAX MODE. Record Ng, TGT, Hz and duct pressure. Is TGT at or near red line? 1
NO
YES
2 AESC
Check Ng trim adjustment at ECU. Is ECU undertrimmed?
YES
To Sheet 2
9 AESC
Adjust Ng trim to engine data plate
NO
3 AESC
Turn trim screw two turns CCW. Did duct pressure increase? 1
YES
10 AESC
Trim to desired duct pressure. Do not exceed 1040°C TGT 1 5
NO
4 APU COMPARTMENT
Reset trim screw two turns CW. Turn three packs on. Select MAX MODE. Visually check IGV position. 1 2 Are IGV's full open?
YES
6 APU COMPARTMENT
Is surge bleed valve fully closed?
NO
11 Refer to fault: APU will not go into NORM mode
YES
NO
5 APU COMPARTMENT
Shut APU down. Replace IGV SYSTEM P3 FILTER, P/N 74-0818. O-RING P/N 74-0789, 22-1214 and 32-5021. Operate APU. Is operation normal?
7 APU COMPARTMENT
Shut APU down. Remove load compressor inlet boot. Check load comp. Is compressor damaged?
YES
12 Replace APU. P/N 28810
NO
NO
To Sheet 3
8 APU COMPARTMENT
Check load compressor inlet duct. Is duct obstructed or damaged?
NO
13 Check aircraft pneumatic system for leaks
YES
14 Remove obstruction or repair damage
NOTE
1 Operate in MAX MODE only long enough to complete check.
2 If ambient temp is above 95°F, reduce gen load to 10 KW or less or IGV's will not go full open.
3 Ng and noise level will increase if vanes go open.
4 EQ1231 tester may be used for this check.
5 Notify MCIEE.
M1-5000-49-739

Low MAX MODE Load Compressor Output
Figure 114 (Sheet 1)


From Sheet 1
1 APU COMPARTMENT
Turn third ECS pack on. Select MAX MODE. Is surge bleed valve fully closed? (1)
NO
6 Refer to fault: APU will not go into NORM mode
YES
2 APU COMPARTMENT
Select NORMAL MODE. Restrict compressor bleed valve final orifice. Does TGT and RPM decrease?
YES
7 Clean ORIFICE BLOCK and replace FILTER, P/N 74-0818. O-RING P/N 74-0789, 22-1214 and 32-5021. If fault persists, replace APU P/N 29610
NO
3 APU COMPARTMENT
Wash gas generator compressor. Does operation improve?
YES
8 Wash gas generator compressor
NO
4 APU COMPARTMENT
Shut APU down. Check APU compressor inlet. Is inlet obstructed?
YES
9 Remove inlet obstruction
NO
5 APU COMPARTMENT
Check TGT trim resistor for proper class and resistance value. Is resistance correct?
YES
10 Replace APU. P/N 29610
NO
11 Replace TRIM RESISTOR

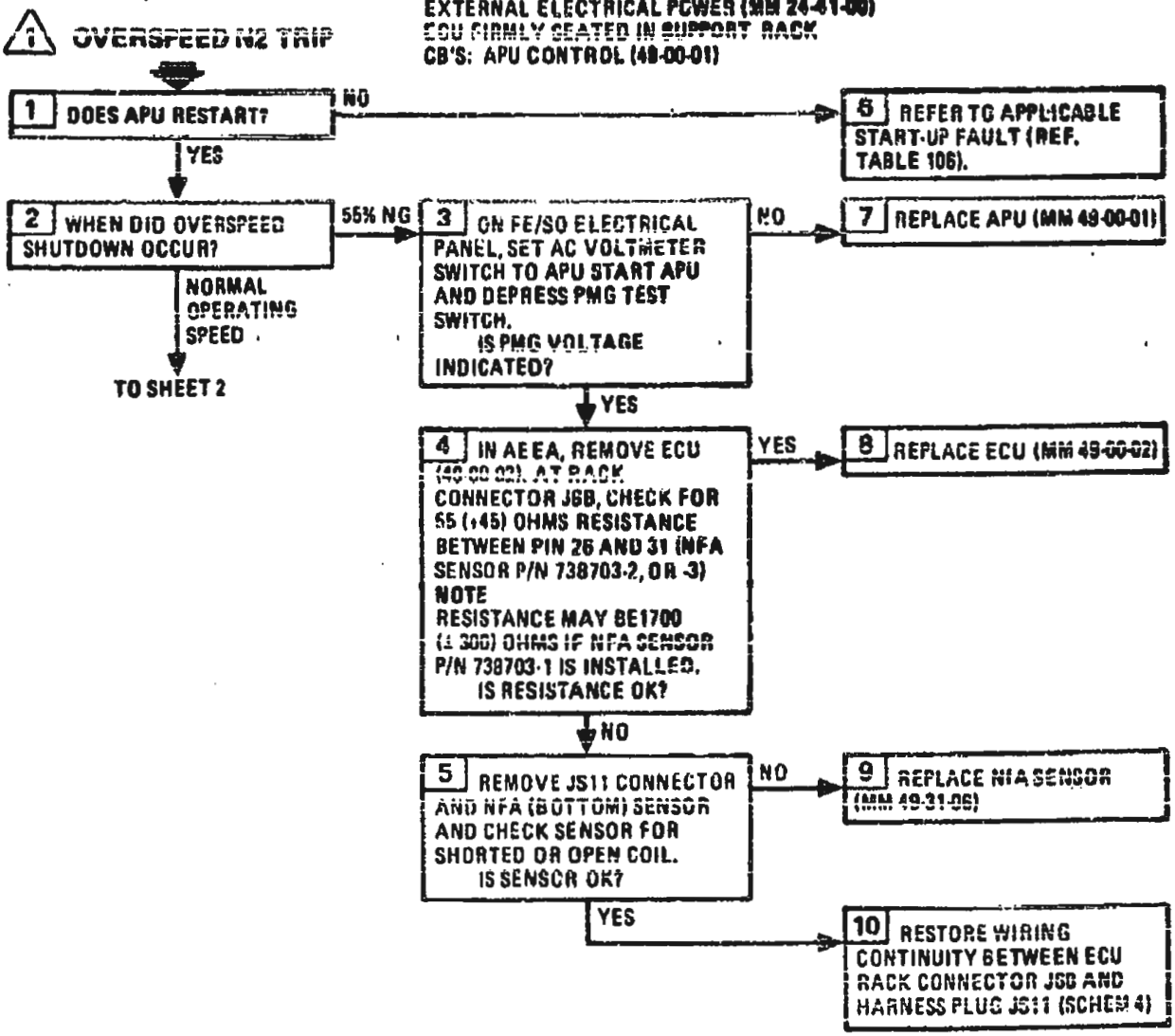
M1-5000-49-734

Low MAX MODE Load Compressor Output
Figure 114 (Sheet 2)


From Sheet 1
1 APU COMPARTMENT
Turn three ECS packs on. Select MAX MODE. Remove JS15 from load compressor controller. Do ICV's go to full open
NO
YES
6 APU COMPARTMENT
Remove air line from IGV actuator. Connect GEN 3395 tester to actuator. Apply 7 to 12 PSIG to actuator. Do IGV's go full open?
NO
YES
9 Replace APU. P/N 29610. IGV assembly is defective
10 Replace load compressor controller P/N 274-0017
2 COCKPIT
Did APU generator frequency droop?
NO
YES
7 AESC
Replace ECU. P/N 31132. Is operation normal?
YES
NO
11 Fault cleared
12 Replace LOAD COMPRESSOR CONTROLLER. P/N 274-0017. If no help, repair wiring. Ref: 49-60-03. Wire No. 82A188LU or No. APU 22 is shorted to ground
3 APU COMPARTMENT
Replace FCU P3 FILTER. FILTER P/N 74-0809. O RING P/N 78-1121 and P/N 27-0195. Is operation normal?
YES
NO
13 Fault cleared
4 AESC
Replace ECU. P/N 31132. Is operation normal?
YES
NO
5 APU COMPARTMENT
Replace FREE TURBINE SPEED CONTROLLER. P/N 274-0018. Is operation normal?
YES
NO
8 APU COMPARTMENT
Replace FCU. P/N 29412. Is operation normal?
NO
YES
14 Before replacing APU, check air inlet for obstructions and P3 air line to FCU for obstructions. P3 GASKETS (2) P/N 74-3212

Low MAX MODE Load Compressor Output
Figure 114 (Sheet 3)

PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM 24-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: APU CONTROL (49-00-01)

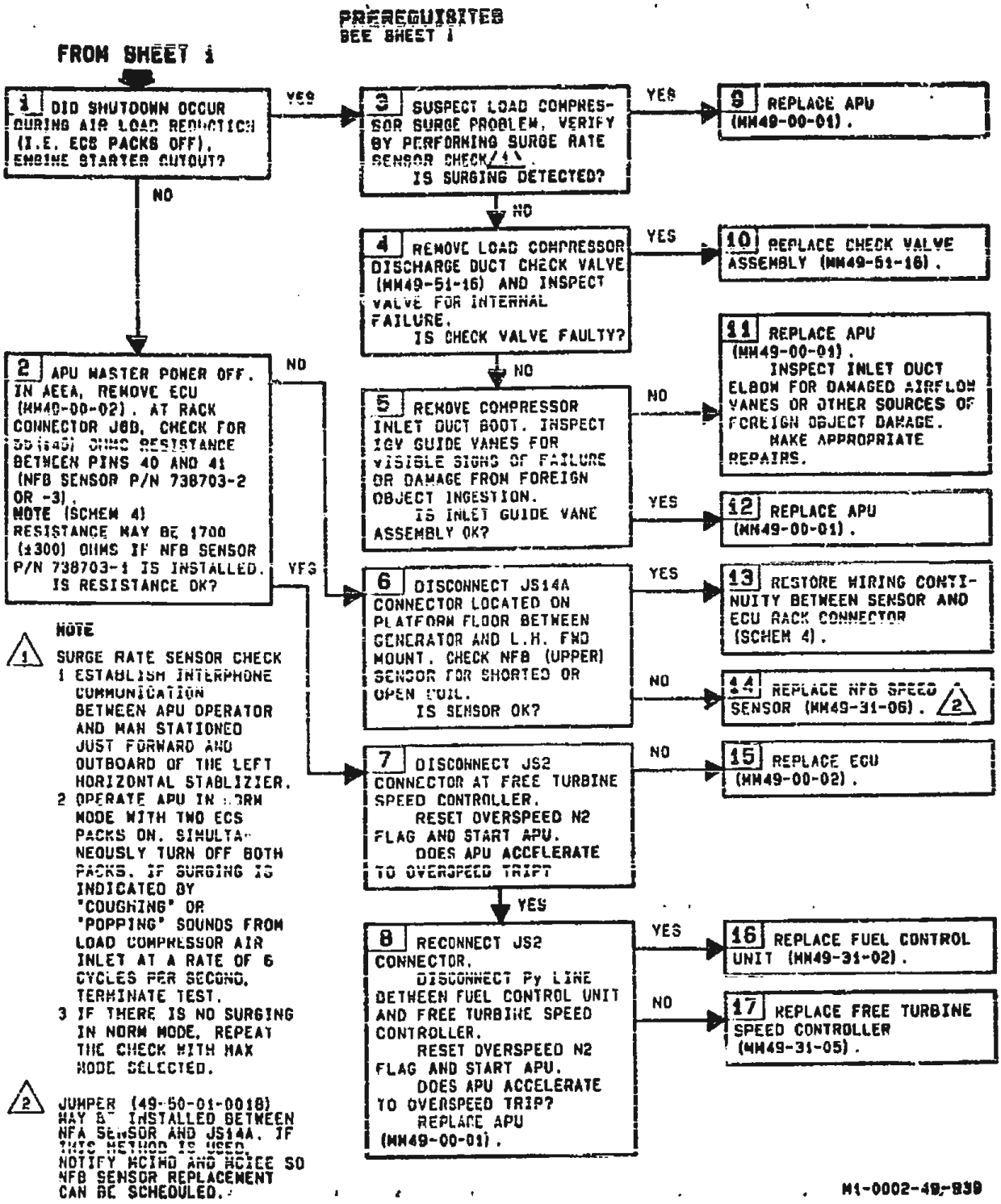

1 OVERSPEED N2 TRIP
1 DOES APU RESTART?
NO
6 REFER TO APPLICABLE START-UP FAULT (REF. TABLE 106).
YES
2 WHEN DID OVERSPEED SHUTDOWN OCCUR?
55% NG
3 ON FE/SO ELECTRICAL PANEL, SET AC VOLTMETER SWITCH TO APU START APU AND DEPRESS PMG TEST SWITCH. IS PMG VOLTAGE INDICATED?
NO
7 REPLACE APU (MM 49-00-01)
NORMAL OPERATING SPEED
TO SHEET 2
YES
4 IN AEEA, REMOVE ECU (49-00-02), AT RACK CONNECTOR J6B, CHECK FOR 55 (±45) OHMS RESISTANCE BETWEEN PIN 26 AND 31 (NFA SENSOR P/N 738703-2, OR -3) NOTE RESISTANCE MAY BE1700 (± 300) OHMS IF NFA SENSOR P/N 738703-1 IS INSTALLED. IS RESISTANCE OK?
YES
8 REPLACE ECU (MM 49-00-02)
NO
5 REMOVE JS11 CONNECTOR AND NFA (BOTTOM) SENSOR AND CHECK SENSOR FOR SHORTED OR OPEN COIL. IS SENSOR OK?
NO
9 REPLACE N1A SENSOR (MM 49-31-06)
YES
10 RESTORE WIRING CONTINUITY BETWEEN ECU RACK CONNECTOR J6B AND HARNESS PLUG JS11 (SCHEM 4)

NOTE

1 IF THIS FAULT OCCURS WHEN APU IS FIRST STARTED AFTER BEING COLD SOAKED (NOT OPERATED FOR LONG PERIOD UNDER VERY LOW TEMPERATURES), PROBLEM IS MOST PROBABLY IN FUEL CONTROL UNIT. REPLACE FCU (MM 49-31-02)

M1-0000-49-000

OVERSPEED N2 Trip
Figure 115 (Sheet 1)


PREREQUISITES
SEE SHEET 1
FROM SHEET 1
1 DID SHUTDOWN OCCUR DURING AIR LOAD REDUCTION (I.E. ECS PACKS OFF), ENGINE STARTER CUTOUT?
YES
NO
3 SUSPECT LOAD COMPRESSOR SURGE PROBLEM, VERIFY BY PERFORMING SURGE RATE SENSOR CHECK/1\. IS SURGING DETECTED?
YES
9 REPLACE APU (MM49-00-01).
NO
4 REMOVE LOAD COMPRESSOR DISCHARGE DUCT CHECK VALVE (MM49-51-16) AND INSPECT VALVE FOR INTERNAL FAILURE. IS CHECK VALVE FAULTY?
YES
10 REPLACE CHECK VALVE ASSEMBLY (MM49-51-16).
NO
5 REMOVE COMPRESSOR INLET DUCT BOOT. INSPECT IGV GUIDE VANES FOR VISIBLE SIGNS OF FAILURE OR DAMAGE FROM FOREIGN OBJECT INGESTION. IS INLET GUIDE VANE ASSEMBLY OK?
NO
11 REPLACE APU (MM49-00-01). INSPECT INLET DUCT ELBOW FOR DAMAGED AIRFLOW VANES OR OTHER SOURCES OF FOREIGN OBJECT DAMAGE. MAKE APPROPRIATE REPAIRS.
YES
12 REPLACE APU (MM49-00-01).
2 APU MASTER POWER OFF. IN AEEA, REMOVE ECU (MM49-00-02). AT RACK CONNECTOR J8B, CHECK FOR 35(±45) OHMS RESISTANCE BETWEEN PINS 40 AND 41 (NFB SENSOR P/N 738703-2 OR -3). NOTE (SCHEM 4) RESISTANCE MAY BE 1700 (±300) OHMS IF NFB SENSOR P/N 738703-1 IS INSTALLED. IS RESISTANCE OK?
NO
YES
6 DISCONNECT JS14A CONNECTOR LOCATED ON PLATFORM FLOOR BETWEEN GENERATOR AND L.H. FWD MOUNT. CHECK NFB (UPPER) SENSOR FOR SHORTED OR OPEN COIL. IS SENSOR OK?
YES
13 RESTORE WIRING CONTINUITY BETWEEN SENSOR AND ECU RACK CONNECTOR (SCHEM 4).
NO
14 REPLACE NFB SPEED SENSOR (MM49-31-06). /2\
7 DISCONNECT JS2 CONNECTOR AT FREE TURBINE SPEED CONTROLLER. RESET OVERSPEED N2 FLAG AND START APU. DOES APU ACCELERATE TO OVERSPEED TRIP?
NO
15 REPLACE ECU (MM49-00-02).
YES
8 RECONNECT JS2 CONNECTOR. DISCONNECT PY LINE BETWEEN FUEL CONTROL UNIT AND FREE TURBINE SPEED CONTROLLER. RESET OVERSPEED N2 FLAG AND START APU. DOES APU ACCELERATE TO OVERSPEED TRIP? REPLACE APU (MM49-00-01).
YES
16 REPLACE FUEL CONTROL UNIT (MM49-31-02).
NO
17 REPLACE FREE TURBINE SPEED CONTROLLER (MM49-31-05).
NOTE
/1\ SURGE RATE SENSOR CHECK
1 ESTABLISH INTERPHONE COMMUNICATION BETWEEN APU OPERATOR AND MAN STATIONED JUST FORWARD AND OUTBOARD OF THE LEFT HORIZONTAL STABLIZIER.
2 OPERATE APU IN NORM MODE WITH TWO ECS PACKS ON. SIMULTANEOUSLY TURN OFF BOTH PACKS. IF SURGING IS INDICATED BY "COUGHING" OR "POPPING" SOUNDS FROM LOAD COMPRESSOR AIR INLET AT A RATE OF 6 CYCLES PER SECOND, TERMINATE TEST.
3 IF THERE IS NO SURGING IN NORM MODE, REPEAT THE CHECK WITH MAX MODE SELECTED.
/2\ JUMPER (49-50-01-0018) MAY BE INSTALLED BETWEEN NFA SENSOR AND JS14A. IF THIS METHOD IS USED, NOTIFY MCIMO AND MCIEE SO NFB SENSOR REPLACEMENT CAN BE SCHEDULED.
M1-0002-49-839

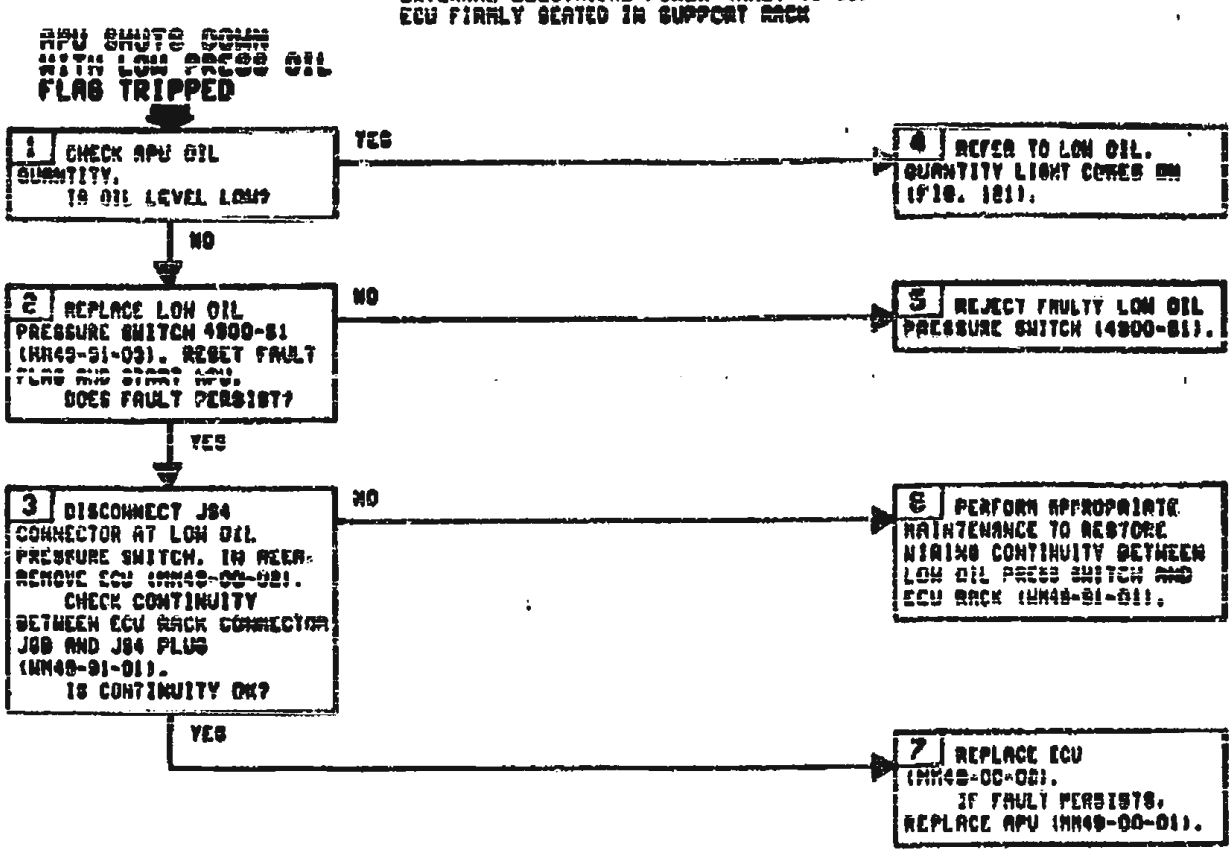
CR
CR

OVERSPEED N2 Trip
Figure 115 (Sheet 2)

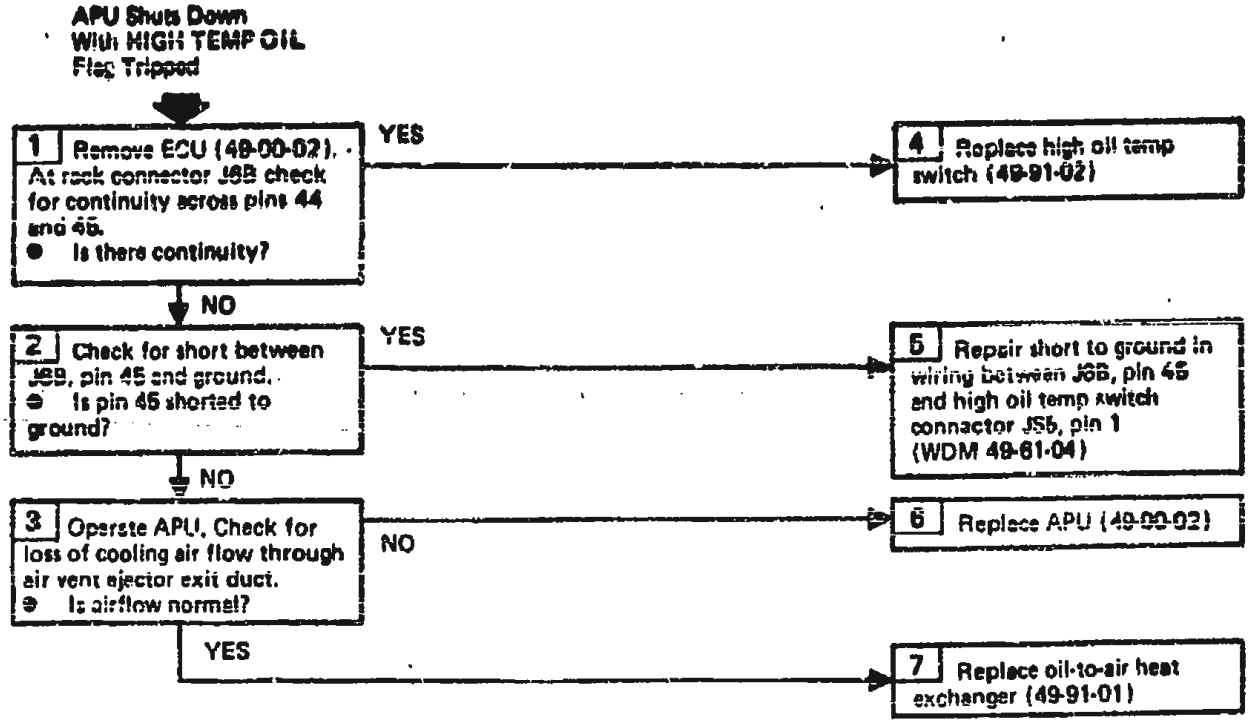
EFFECTIVITY: ALL

002B

PREREQUISITES
EXTERNAL ELECTRICAL POWER (HH24-41-00)
ECU FIRMLY SEATED IN SUPPORT RACK


APU SHUTS DOWN WITH LOW PRESS OIL FLAG TRIPPED
1 CHECK APU OIL QUANTITY. IS OIL LEVEL LOW?
YES
4 REFER TO LOW OIL QUANTITY LIGHT CODES ON (FIG. 101).
NO
2 REPLACE LOW OIL PRESSURE SWITCH 4800-81 (HH49-91-03). RESET FAULT FLAG AND START APU. DOES FAULT PERSIST?
NO
5 REJECT FAULTY LOW OIL PRESSURE SWITCH (4800-81).
YES
3 DISCONNECT J84 CONNECTOR AT LOW OIL PRESSURE SWITCH. IN REAR REMOVE ECU (HH49-00-02). CHECK CONTINUITY BETWEEN ECU RACK CONNECTOR J88 AND J84 PLUG (HH49-91-01). IS CONTINUITY OK?
NO
6 PERFORM APPROPRIATE MAINTENANCE TO RESTORE WIRING CONTINUITY BETWEEN LOW OIL PRESS SWITCH AND ECU RACK (HH49-91-01).
YES
7 REPLACE ECU (HH49-00-02). IF FAULT PERSISTS, REPLACE APU (HH49-00-01).

APU Shuts Down With LOW PRESS OIL Flag Tripped
Figure 116


APU Shuts Down
With HIGH TEMP OIL
Flag Tripped
1 Remove ECU (49-00-02). At rack connector J6B check for continuity across pins 44 and 45.
● Is there continuity?
YES
4 Replace high oil temp switch (49-91-02)
NO
2 Check for short between J6B, pin 45 and ground.
● Is pin 45 shorted to ground?
YES
5 Repair short to ground in wiring between J6B, pin 45 and high oil temp switch connector J55, pin 1 (WDM 49-61-04)
NO
3 Operate APU. Check for loss of cooling air flow through air vent ejector exit duct.
● Is airflow normal?
NO
6 Replace APU (49-00-02)
YES
7 Replace oil-to-air heat exchanger (49-91-01)

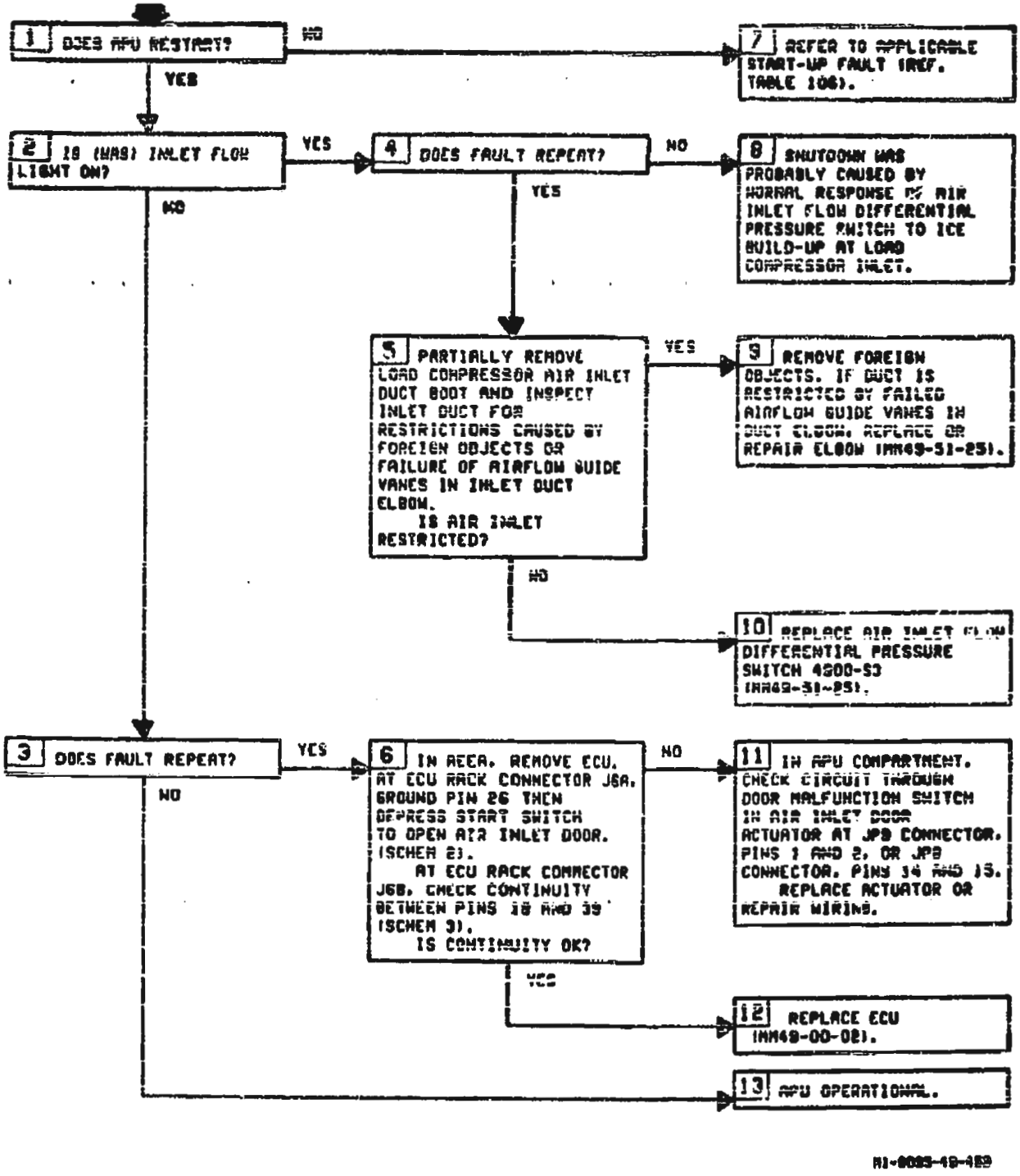
PREREQUISITES
External electrical power (24-41-00)
CB's: CB3-B9 through B17
CB3-S12

M1-0002-49-184

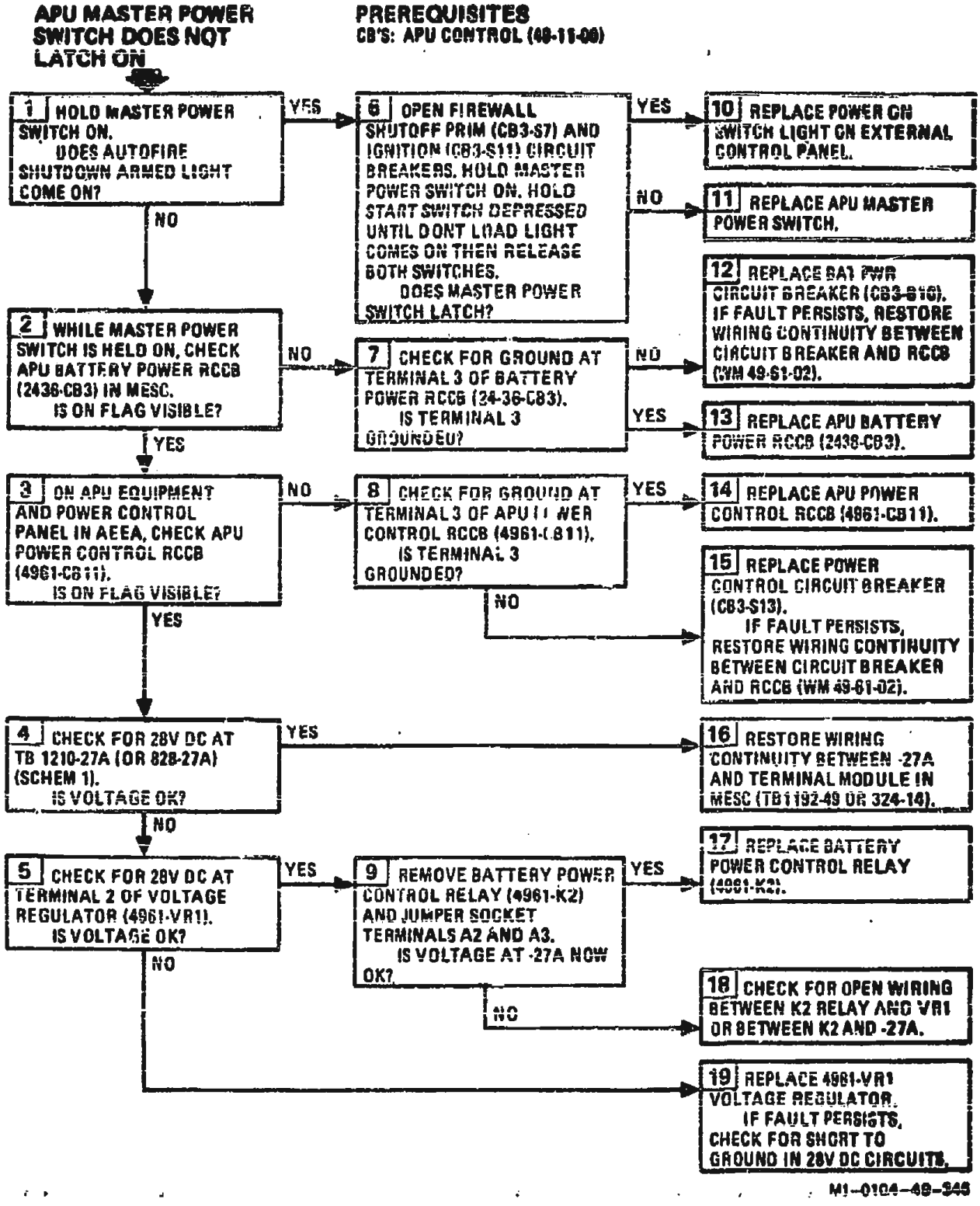
APU Shuts Down With HIGH TEMP OIL Flag Tripped
Figure 117

APU AUTO SHUTDOWN; NO FAULT FLAG

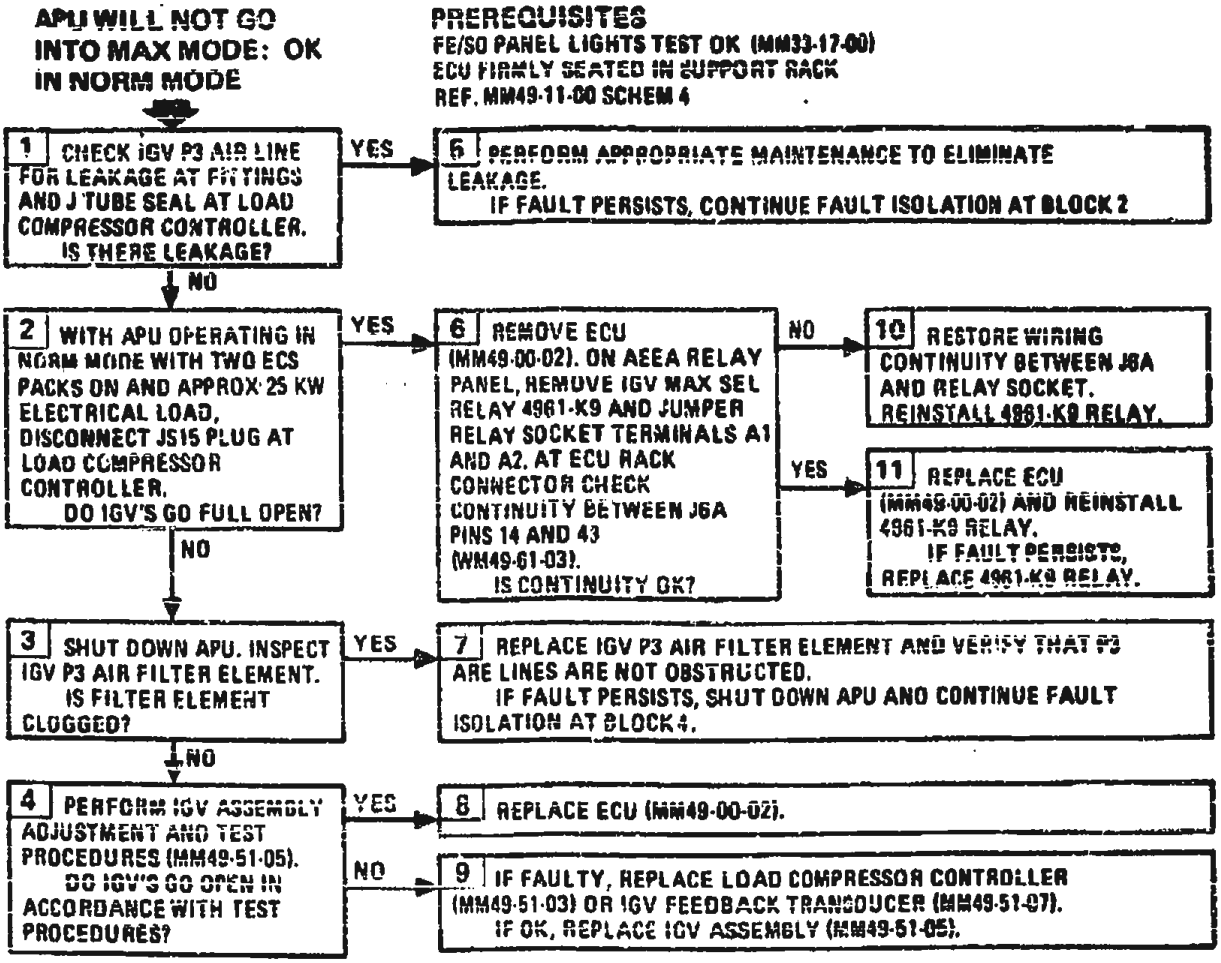
PREREQUISITES
NONE


1 DOES APU RESTART?
NO
YES
7 REFER TO APPLICABLE START-UP FAULT (REF. TABLE 106).
2 IS (WAS) INLET FLOW LIGHT ON?
YES
NO
4 DOES FAULT REPEAT?
NO
YES
8 SHUTDOWN WAS PROBABLY CAUSED BY NORMAL RESPONSE OF AIR INLET FLOW DIFFERENTIAL PRESSURE SWITCH TO ICE BUILD-UP AT LOAD COMPRESSOR INLET.
5 PARTIALLY REMOVE LOAD COMPRESSOR AIR INLET DUCT BOOT AND INSPECT INLET DUCT FOR RESTRICTIONS CAUSED BY FOREIGN OBJECTS OR FAILURE OF AIRFLOW GUIDE VANES IN INLET DUCT ELBOW.
IS AIR INLET RESTRICTED?
YES
9 REMOVE FOREIGN OBJECTS. IF DUCT IS RESTRICTED BY FAILED AIRFLOW GUIDE VANES IN DUCT ELBOW, REPLACE OR REPAIR ELBOW (MM49-51-251).
NO
10 REPLACE AIR INLET FLOW DIFFERENTIAL PRESSURE SWITCH 4300-53 (MM49-31-251).
3 DOES FAULT REPEAT?
YES
NO
6 IN AFCA, REMOVE ECU. AT ECU RACK CONNECTOR J6A, GROUND PIN 26 THEN DEPRESS START SWITCH TO OPEN AIR INLET DOOR. (SCHEM 2).
AT ECU RACK CONNECTOR J6B, CHECK CONTINUITY BETWEEN PINS 18 AND 39 (SCHEM 3).
IS CONTINUITY OK?
NO
YES
11 IN APU COMPARTMENT, CHECK CIRCUIT THROUGH DOOR MALFUNCTION SWITCH IN AIR INLET DOOR ACTUATOR AT J98 CONNECTOR, PINS 1 AND 2, OR J98 CONNECTOR, PINS 34 AND 35. REPLACE ACTUATOR OR REPAIR WIRING.
12 REPLACE ECU (MM49-00-02).
13 APU OPERATIONAL.

APU Auto Shutdown; No Fault Flag
Figure 118

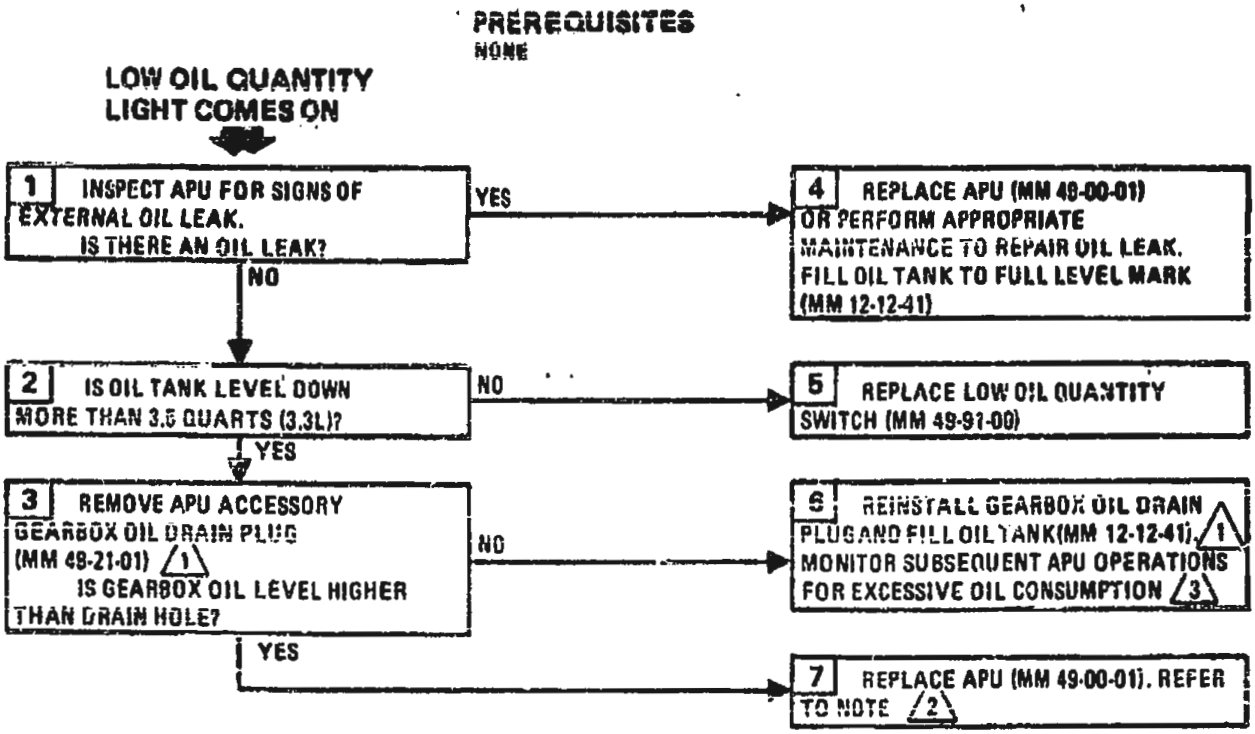

APU MASTER POWER SWITCH DOES NOT LATCH ON
PREREQUISITES
CB'S: APU CONTROL (49-11-00)
1 HOLD MASTER POWER SWITCH ON.
DOES AUTOFIRE SHUTDOWN ARMED LIGHT COME ON?
YES
NO
2 WHILE MASTER POWER SWITCH IS HELD ON, CHECK APU BATTERY POWER RCCB (2438-CB3) IN MESC.
IS ON FLAG VISIBLE?
NO
YES
3 ON APU EQUIPMENT AND POWER CONTROL PANEL IN AEEA, CHECK APU POWER CONTROL RCCB (4961-CB11).
IS ON FLAG VISIBLE?
NO
YES
4 CHECK FOR 28V DC AT TB 1210-27A (OR 828-27A) (SCHEM 1).
IS VOLTAGE OK?
YES
NO
5 CHECK FOR 28V DC AT TERMINAL 2 OF VOLTAGE REGULATOR (4961-VR1).
IS VOLTAGE OK?
YES
NO
6 OPEN FIREWALL SHUTOFF PRIM (CB3-S7) AND IGNITION (CB3-S11) CIRCUIT BREAKERS. HOLD MASTER POWER SWITCH ON. HOLD START SWITCH DEPRESSED UNTIL DONT LOAD LIGHT COMES ON THEN RELEASE BOTH SWITCHES.
DOES MASTER POWER SWITCH LATCH?
YES
NO
7 CHECK FOR GROUND AT TERMINAL 3 OF BATTERY POWER RCCB (24-36-CB3).
IS TERMINAL 3 GROUNDED?
NO
YES
8 CHECK FOR GROUND AT TERMINAL 3 OF APU POWER CONTROL RCCB (4961-CB11).
IS TERMINAL 3 GROUNDED?
YES
NO
9 REMOVE BATTERY POWER CONTROL RELAY (4961-K2) AND JUMPER SOCKET TERMINALS A2 AND A3.
IS VOLTAGE AT -27A NOW OK?
YES
NO
10 REPLACE POWER ON SWITCH LIGHT ON EXTERNAL CONTROL PANEL.
11 REPLACE APU MASTER POWER SWITCH.
12 REPLACE BAT PWR CIRCUIT BREAKER (CB3-S16). IF FAULT PERSISTS, RESTORE WIRING CONTINUITY BETWEEN CIRCUIT BREAKER AND RCCB (WM 49-61-02).
13 REPLACE APU BATTERY POWER RCCB (2438-CB3).
14 REPLACE APU POWER CONTROL RCCB (4961-CB11).
15 REPLACE POWER CONTROL CIRCUIT BREAKER (CB3-S13).
IF FAULT PERSISTS, RESTORE WIRING CONTINUITY BETWEEN CIRCUIT BREAKER AND RCCB (WM 49-61-02).
16 RESTORE WIRING CONTINUITY BETWEEN -27A AND TERMINAL MODULE IN MESC (TB1192-49 OR 324-14).
17 REPLACE BATTERY POWER CONTROL RELAY (4961-K2).
18 CHECK FOR OPEN WIRING BETWEEN K2 RELAY AND VR1 OR BETWEEN K2 AND -27A.
19 REPLACE 4961-VR1 VOLTAGE REGULATOR.
IF FAULT PERSISTS, CHECK FOR SHORT TO GROUND IN 28V DC CIRCUITS.
M1-0104-49-346

APU MASTER POWER Switch Does Not Latch On
Figure 119


APU WILL NOT GO INTO MAX MODE: OK IN NORM MODE
PREREQUISITES
FE/SO PANEL LIGHTS TEST OK (MM33-17-00)
ECU FIRMLY SEATED IN SUPPORT RACK
REF. MM49-11-00 SCHEM 4
1 CHECK IGV P3 AIR LINE FOR LEAKAGE AT FITTINGS AND J TUBE SEAL AT LOAD COMPRESSOR CONTROLLER. IS THERE LEAKAGE?
YES
5 PERFORM APPROPRIATE MAINTENANCE TO ELIMINATE LEAKAGE. IF FAULT PERSISTS, CONTINUE FAULT ISOLATION AT BLOCK 2
NO
2 WITH APU OPERATING IN NORM MODE WITH TWO ECS PACKS ON AND APPROX 25 KW ELECTRICAL LOAD, DISCONNECT JS15 PLUG AT LOAD COMPRESSOR CONTROLLER. DO IGV'S GO FULL OPEN?
YES
6 REMOVE ECU (MM49-00-02). ON AEEA RELAY PANEL, REMOVE IGV MAX SEL RELAY 4961-K9 AND JUMPER RELAY SOCKET TERMINALS A1 AND A2. AT ECU RACK CONNECTOR CHECK CONTINUITY BETWEEN J6A PINS 14 AND 43 (WM49-61-03). IS CONTINUITY OK?
NO
10 RESTORE WIRING CONTINUITY BETWEEN J6A AND RELAY SOCKET. REINSTALL 4961-K9 RELAY.
YES
11 REPLACE ECU (MM49-00-02) AND REINSTALL 4961-K9 RELAY. IF FAULT PERSISTS, REPLACE 4961-K9 RELAY.
NO
3 SHUT DOWN APU. INSPECT IGV P3 AIR FILTER ELEMENT. IS FILTER ELEMENT CLOGGED?
YES
7 REPLACE IGV P3 AIR FILTER ELEMENT AND VERIFY THAT P3 AIR LINES ARE NOT OBSTRUCTED. IF FAULT PERSISTS, SHUT DOWN APU AND CONTINUE FAULT ISOLATION AT BLOCK 4.
NO
4 PERFORM IGV ASSEMBLY ADJUSTMENT AND TEST PROCEDURES (MM49-51-05). DO IGV'S GO OPEN IN ACCORDANCE WITH TEST PROCEDURES?
YES
8 REPLACE ECU (MM49-00-02).
NO
9 IF FAULTY, REPLACE LOAD COMPRESSOR CONTROLLER (MM49-51-03) OR IGV FEEDBACK TRANSDUCER (MM49-51-07). IF OK, REPLACE IGV ASSEMBLY (MM49-51-05).

M1-0001-49-1064

R R APU Will Not Go Into MAX MODE; OK In NORM MODE
Figure 120


PREREQUISITES
NONE
LOW OIL QUANTITY LIGHT COMES ON
1 INSPECT APU FOR SIGNS OF EXTERNAL OIL LEAK. IS THERE AN OIL LEAK?
YES
4 REPLACE APU (MM 49-00-01) OR PERFORM APPROPRIATE MAINTENANCE TO REPAIR OIL LEAK. FILL OIL TANK TO FULL LEVEL MARK (MM 12-12-41)
NO
2 IS OIL TANK LEVEL DOWN MORE THAN 3.5 QUARTS (3.3L)?
NO
5 REPLACE LOW OIL QUANTITY SWITCH (MM 49-91-00)
YES
3 REMOVE APU ACCESSORY GEARBOX OIL DRAIN PLUG (MM 49-21-01) /1\ IS GEARBOX OIL LEVEL HIGHER THAN DRAIN HOLE?
NO
6 REINSTALL GEARBOX OIL DRAIN PLUG AND FILL OIL TANK (MM 12-12-41). /1\ MONITOR SUBSEQUENT APU OPERATIONS FOR EXCESSIVE OIL CONSUMPTION /3\
YES
7 REPLACE APU (MM 49-00-01). REFER TO NOTE /2\

NOTE

/1\ A FLIGHT CREW REPORT OF A LOW OIL QUANTITY LIGHT ON WHEN APU IS STARTED AFTER LANDING CAN BE CAUSED BY AN ACCUMULATION OF EXCESS OIL IN THE ACCESSORY GEARBOX BY IN-FLIGHT WINDMILLING OF THE APU. ADDING MORE OIL TO RESTORE THE OIL TANK LEVEL WITHOUT FIRST DRAINING EXCESS OIL FROM THE ACCESSORY GEARBOX CAN RESULT IN OVERFILLING THE SYSTEM AND EXCESSIVE LOSS OF OIL THROUGH THE ENGINE BREATHER LINE.

/2\ AN ACCUMULATION OF EXCESS OIL IN THE ACCESSORY GEARBOX CAN ALSO BE CAUSED BY FAULTY PREFORMED PACKING ON THE OIL FILTER BYPASS PISTON AND FAULTY SEALS IN THE ACCESSORY CASE GEARBOX.

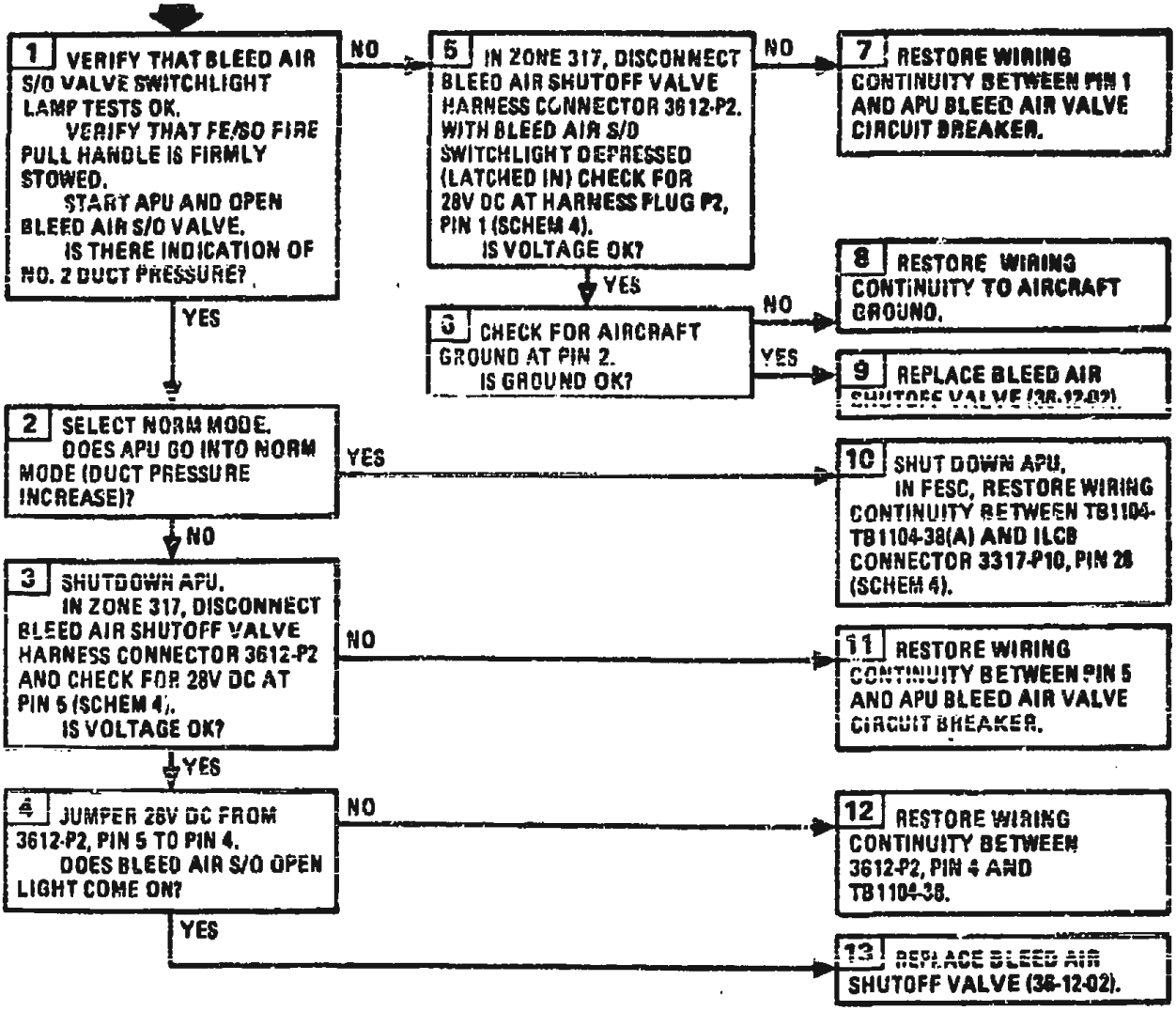
/3\ OIL CONSUMPTION ABOVE 5.0 U.S. QUARTS PER 100 HOURS INDICATES AN APU DEFECT. THE LENGTH OF TIME AN APU IS KEPT IN SERVICE SHOULD BE DECIDED BY THE OIL CONSUMPTION RATE, THE OIL SERVICING FREQUENCY, AND THE LOCATION OF OIL LOSS, WHETHER INTERNAL OR EXTERNAL. AN INTERNAL OIL LEAK WILL HAVE AN UNDESIRABLE EFFECT ON APU PERFORMANCE AND THE APU SHOULD BE CHANGED AS SOON AS PRACTICABLE.

M1-0000-49-1B9

R LOW OIL QUANTITY Light Comes On
R Figure 121

EFFECTIVITY: ALL

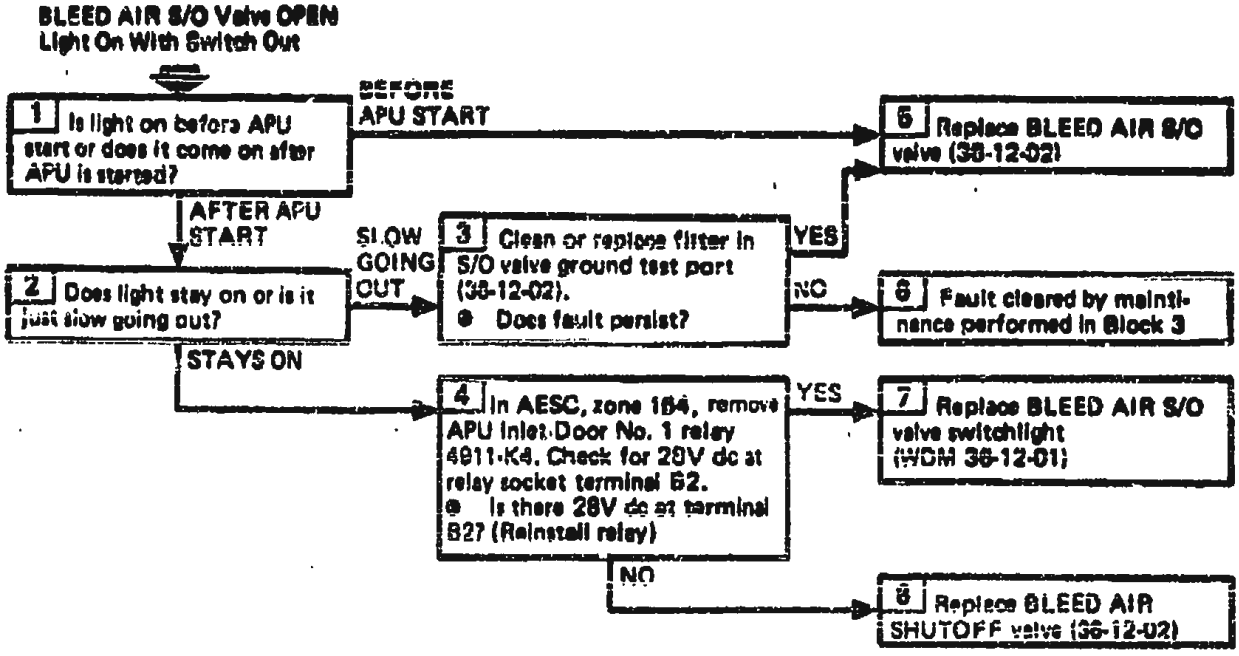
PREREQUISITES
EXTERNAL ELECTRICAL POWER (24-41-00)
CB'S: APU CONTROL (49-00-01)


BLEED AIR S/O VALVE OPEN LIGHT DOES NOT COME ON
1 VERIFY THAT BLEED AIR S/O VALVE SWITCHLIGHT LAMP TESTS OK.
VERIFY THAT FE/SO FIRE PULL HANDLE IS FIRMLY STOWED.
START APU AND OPEN BLEED AIR S/O VALVE.
IS THERE INDICATION OF NO. 2 DUCT PRESSURE?
NO
YES
5 IN ZONE 317, DISCONNECT BLEED AIR SHUTOFF VALVE HARNESS CONNECTOR 3612-P2. WITH BLEED AIR S/O SWITCHLIGHT DEPRESSED (LATCHED IN) CHECK FOR 28V DC AT HARNESS PLUG P2, PIN 1 (SCHEM 4).
IS VOLTAGE OK?
NO
YES
7 RESTORE WIRING CONTINUITY BETWEEN PIN 1 AND APU BLEED AIR VALVE CIRCUIT BREAKER.
6 CHECK FOR AIRCRAFT GROUND AT PIN 2.
IS GROUND OK?
NO
YES
8 RESTORE WIRING CONTINUITY TO AIRCRAFT GROUND.
9 REPLACE BLEED AIR SHUTOFF VALVE (36-12-02).
2 SELECT NORM MODE.
DOES APU GO INTO NORM MODE (DUCT PRESSURE INCREASE)?
YES
NO
10 SHUT DOWN APU.
IN FESC, RESTORE WIRING CONTINUITY BETWEEN TB1104-TB1104-38(A) AND ILCB CONNECTOR 3317-P10, PIN 28 (SCHEM 4).
3 SHUTDOWN APU.
IN ZONE 317, DISCONNECT BLEED AIR SHUTOFF VALVE HARNESS CONNECTOR 3612-P2 AND CHECK FOR 28V DC AT PIN 5 (SCHEM 4).
IS VOLTAGE OK?
NO
YES
11 RESTORE WIRING CONTINUITY BETWEEN PIN 5 AND APU BLEED AIR VALVE CIRCUIT BREAKER.
4 JUMPER 28V DC FROM 3612-P2, PIN 5 TO PIN 4.
DOES BLEED AIR S/O OPEN LIGHT COME ON?
NO
YES
12 RESTORE WIRING CONTINUITY BETWEEN 3612-P2, PIN 4 AND TB1104-38.
13 REPLACE BLEED AIR SHUTOFF VALVE (36-12-02).

NOTE
THE BLEED AIR S/O OPEN LIGHT IS TURNED ON BY A MECHANICALLY ACTUATED SWITCH IN THE BLEED AIR SHUTOFF VALVE WHEN THE VALVE HAS OPENED 3 TO 18 DEGREES

M1-0103-49-844

BLEED AIR S/O OPEN Light Does Not Come On
Figure 122


BLEED AIR S/O Valve OPEN Light On With Switch Out
1 Is light on before APU start or does it come on after APU is started?
BEFORE APU START
5 Replace BLEED AIR S/O valve (36-12-02)
AFTER APU START
2 Does light stay on or is it just slow going out?
SLOW GOING OUT
3 Clean or replace filter in S/O valve ground test port (36-12-02).
● Does fault persist?
YES
NO
6 Fault cleared by maintenance performed in Block 3
STAYS ON
4 In AESC, zone 164, remove APU Inlet Door No. 1 relay 4911-K4. Check for 28V dc at relay socket terminal B2.
● Is there 28V dc at terminal B2? (Reinstall relay)
YES
7 Replace BLEED AIR S/O valve switchlight (WDM 36-12-01)
NO
8 Replace BLEED AIR SHUTOFF valve (36-12-02)

PREREQUISITE

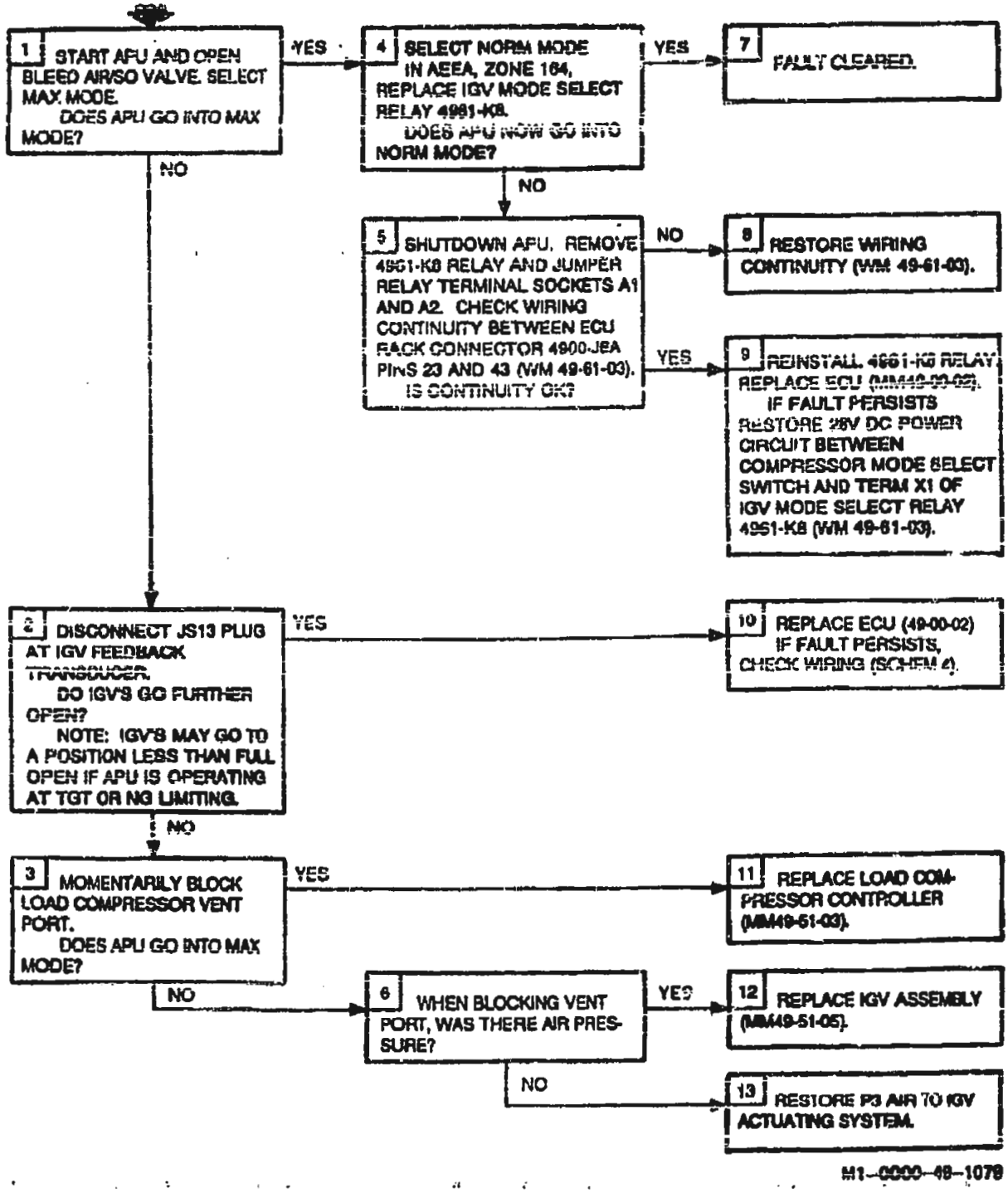
DC ESS BUS energized
CB: CB2-B18
FE/SO panel lights test OK

M1-0101-49-660

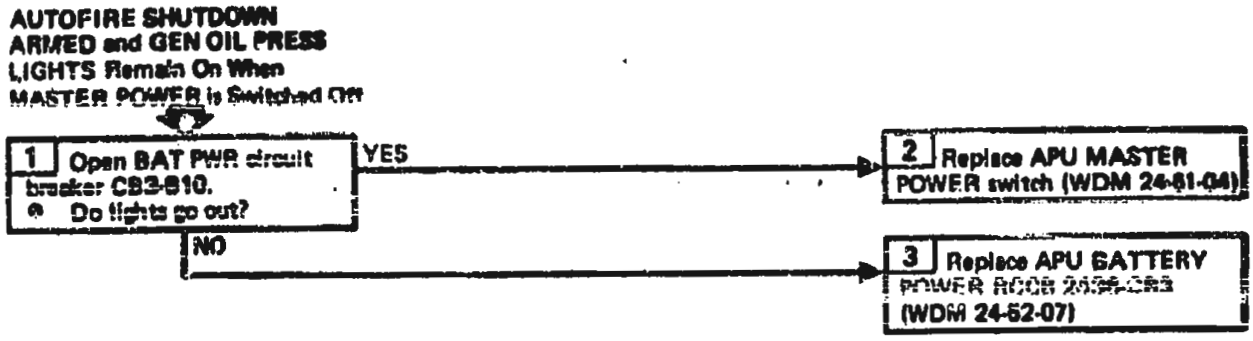
BLEED AIR S/O OPEN Light On With Switch Out
Figure 123

PREREQUISITES

EXTERNAL ELECTRICAL POWER (MM24-41-03)
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: APU CONTROL (MM49-00-01)

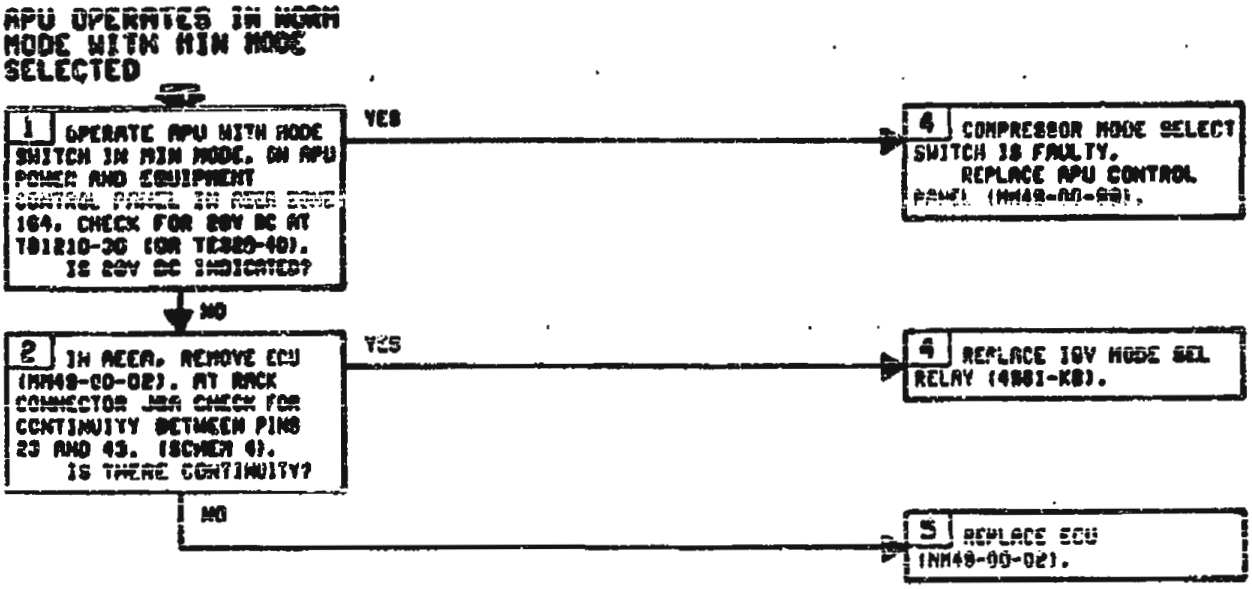

APU WILL NOT GO INTO NORM MODE
1 START APU AND OPEN BLEED AIR/SO VALVE. SELECT MAX MODE.
DOES APU GO INTO MAX MODE?
YES
4 SELECT NORM MODE IN AEEA, ZONE 164, REPLACE IGV MODE SELECT RELAY 4951-K8.
DOES APU NOW GO INTO NORM MODE?
YES
7 FAULT CLEARED.
NO
5 SHUTDOWN APU. REMOVE 4951-K8 RELAY AND JUMPER RELAY TERMINAL SOCKETS A1 AND A2. CHECK WIRING CONTINUITY BETWEEN ECU RACK CONNECTOR 4900-J6A PINS 23 AND 43 (WM 49-61-03).
IS CONTINUITY OK?
NO
8 RESTORE WIRING CONTINUITY (WM 49-61-03).
YES
9 REINSTALL 4951-K8 RELAY. REPLACE ECU (MM49-00-02).
IF FAULT PERSISTS RESTORE 28V DC POWER CIRCUIT BETWEEN COMPRESSOR MODE SELECT SWITCH AND TERM X1 OF IGV MODE SELECT RELAY 4951-K8 (WM 49-61-03).
NO
2 DISCONNECT J513 PLUG AT IGV FEEDBACK TRANSDUCER.
DO IGV'S GO FURTHER OPEN?
NOTE: IGV'S MAY GO TO A POSITION LESS THAN FULL OPEN IF APU IS OPERATING AT TGT OR NG LIMITING.
YES
10 REPLACE ECU (49-00-02)
IF FAULT PERSISTS, CHECK WIRING (SCHEM 4).
NO
3 MOMENTARILY BLOCK LOAD COMPRESSOR VENT PORT.
DOES APU GO INTO MAX MODE?
YES
11 REPLACE LOAD COMPRESSOR CONTROLLER (MM49-51-03).
NO
6 WHEN BLOCKING VENT PORT, WAS THERE AIR PRESSURE?
YES
12 REPLACE IGV ASSEMBLY (MM49-51-05).
NO
13 RESTORE P3 AIR TO IGV ACTUATING SYSTEM.
M1-0000-49-1079

R R APU Does Not Go Into NORM Mode
Figure 124



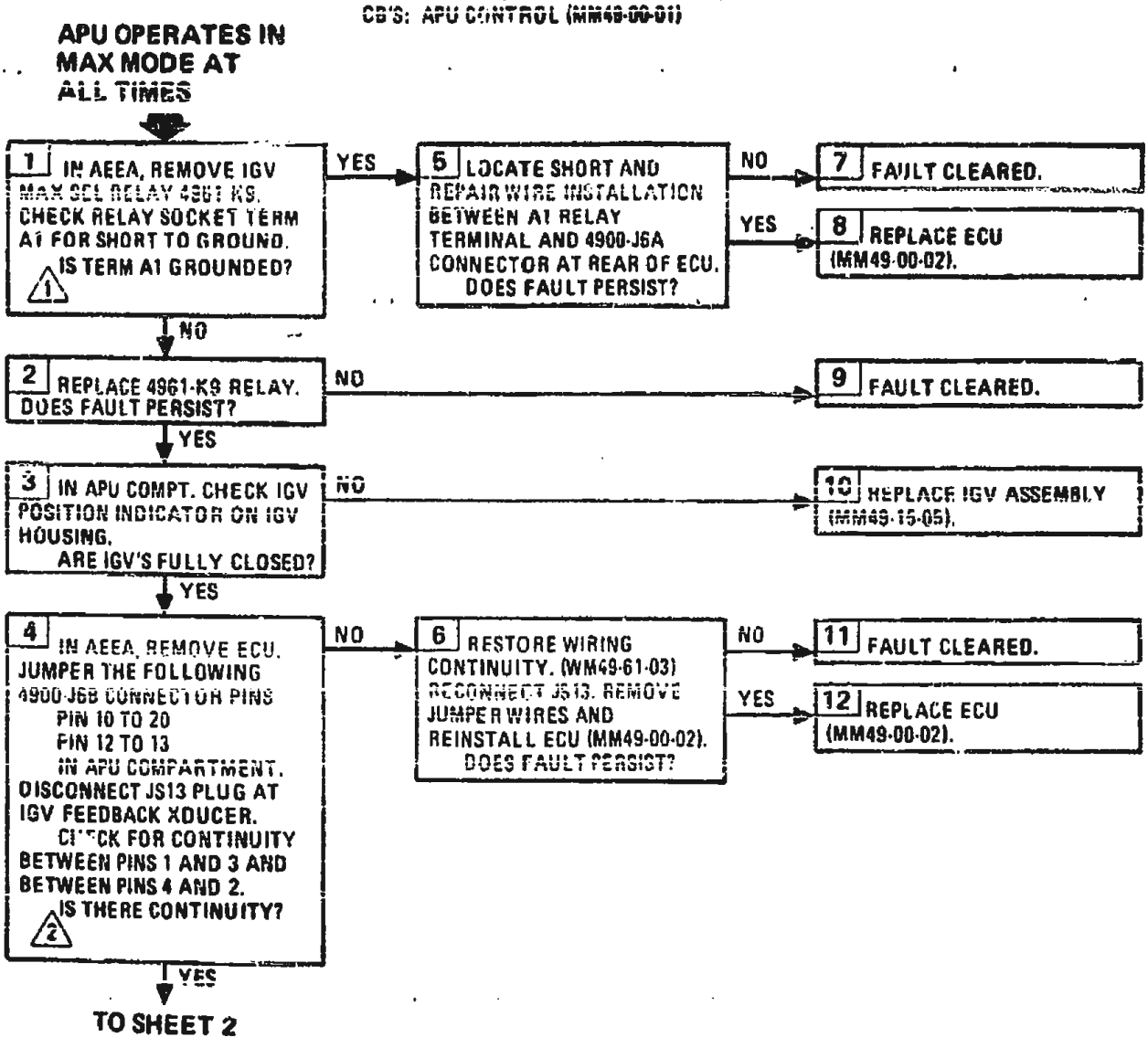
AUTOFIRE SHUTDOWN ARMED and GEN OIL PRESS Lights Remain On When MASTER POWER is Switched Off
Figure 125

PREREQUISITES
CB'S: C03-09 THROUGH 017
C03-29 THROUGH 518


APU OPERATES IN NORM MODE WITH MIN MODE SELECTED
1 OPERATE APU WITH MODE SWITCH IN MIN MODE. ON APU POWER AND EQUIPMENT CONTROL PANEL IN ACCP 164, CHECK FOR 28V DC AT TB1210-3G (OR TB280-4B). IS 28V DC INDICATED?
YES
4 COMPRESSOR MODE SELECT SWITCH IS FAULTY. REPLACE APU CONTROL PANEL (NN48-00-001).
NO
2 IN ACCP, REMOVE ECU (NN48-00-02). AT RACK CONNECTOR J6A CHECK FOR CONTINUITY BETWEEN PINS 23 AND 43. (SCHEM 4). IS THERE CONTINUITY?
YES
4 REPLACE 18V MODE SEL RELAY (4881-K8).
NO
5 REPLACE ECU (NN48-00-02).

R Figure 126 APU Operates in NORM Mode, With MIN Mode Selected

PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
FE/SO PANEL LIGHTS TEST OK
ECU FIRMLY SEATED IN SUPPORT RACK
CB'S: APU CONTROL (MM49-00-01)


APU OPERATES IN MAX MODE AT ALL TIMES
1 IN AEEA, REMOVE IGV MAX SEL RELAY 4961 K9. CHECK RELAY SOCKET TERM A1 FOR SHORT TO GROUND. IS TERM A1 GROUNDED? 1
YES
5 LOCATE SHORT AND REPAIR WIRE INSTALLATION BETWEEN A1 RELAY TERMINAL AND 4900-J6A CONNECTOR AT REAR OF ECU. DOES FAULT PERSIST?
NO
7 FAULT CLEARED.
YES
8 REPLACE ECU (MM49-00-02).
NO
2 REPLACE 4961-K9 RELAY. DOES FAULT PERSIST?
NO
9 FAULT CLEARED.
YES
3 IN APU COMPT. CHECK IGV POSITION INDICATOR ON IGV HOUSING. ARE IGV'S FULLY CLOSED?
NO
10 REPLACE IGV ASSEMBLY (MM49-15-05).
YES
4 IN AEEA, REMOVE ECU. JUMPER THE FOLLOWING 4900-J6B CONNECTOR PINS PIN 10 TO 20 PIN 12 TO 13 IN APU COMPARTMENT. DISCONNECT JS13 PLUG AT IGV FEEDBACK XDUCER. CHECK FOR CONTINUITY BETWEEN PINS 1 AND 3 AND BETWEEN PINS 4 AND 2. IS THERE CONTINUITY? 2
NO
6 RESTORE WIRING CONTINUITY. (WM49-61-03) RECONNECT JS13. REMOVE JUMPER WIRES AND REINSTALL ECU (MM49-00-02). DOES FAULT PERSIST?
NO
11 FAULT CLEARED.
YES
12 REPLACE ECU (MM49-00-02).
YES
TO SHEET 2

1 **NOTE**
A SHORT GND IN WIRING FROM MAX MODE SEL RELAY A1 TERM TO ECU WILL CAUSE ECU TO DRIVE APU INTO MAX MODE

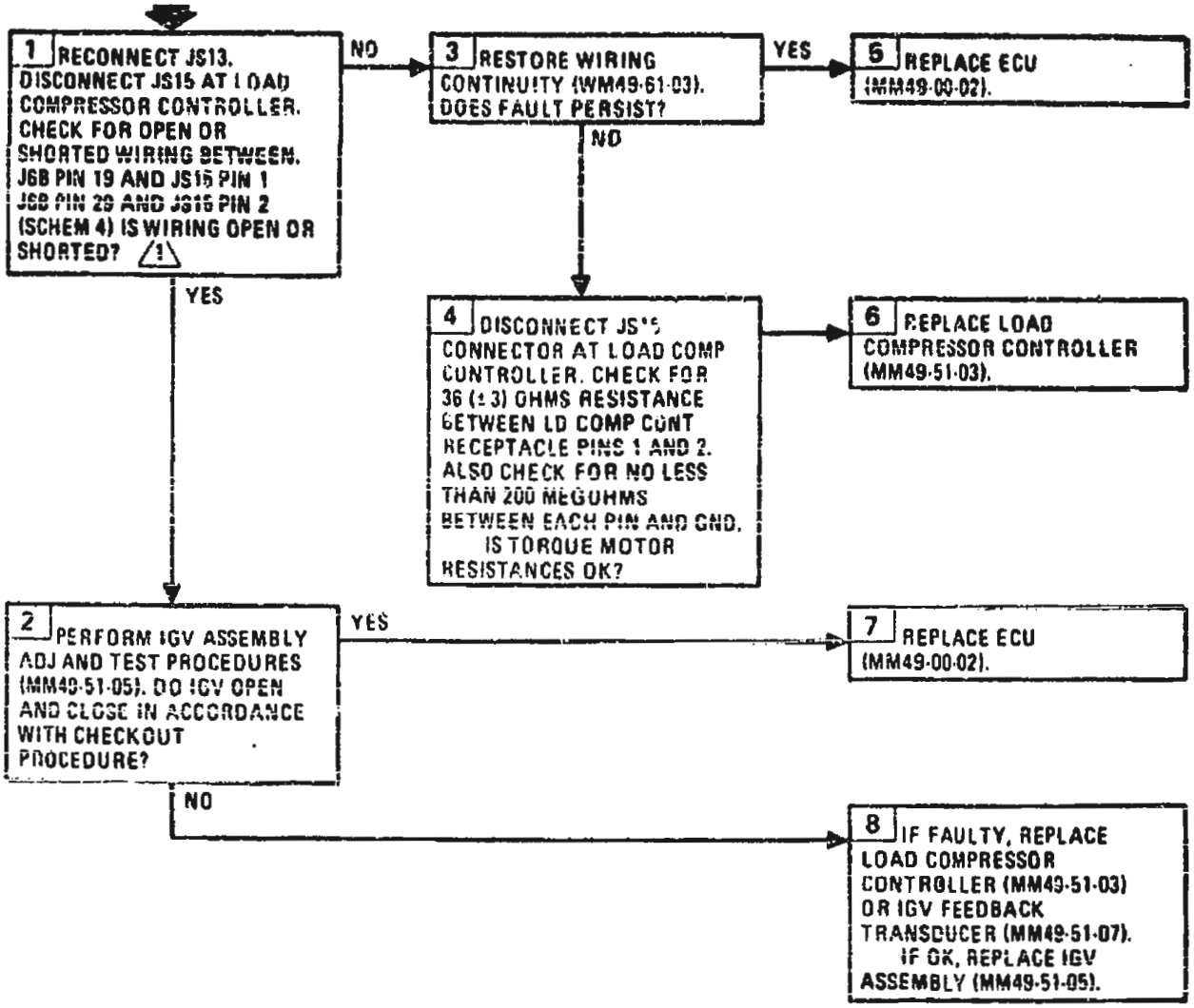
2 SEE SCHEM 4 (WM49-61-03). A LOSS OF IGV POSITION SIGNAL TO ECU WILL CAUSE ECU TO COMMAND MAX MODE OPERATION

M1-0006-49-548

APU Operates in MAX MODE At All Times
Figure 127 (Sheet 1)

PREREQUISITES
SEE SHEET 1

FROM SHEET 1


1 RECONNECT JS13. DISCONNECT JS15 AT LOAD COMPRESSOR CONTROLLER. CHECK FOR OPEN OR SHORTED WIRING BETWEEN. J6B PIN 19 AND JS15 PIN 1 J6B PIN 29 AND JS15 PIN 2 (SCHEM 4) IS WIRING OPEN OR SHORTED? ⚠1
NO
3 RESTORE WIRING CONTINUITY (WM49-61-03). DOES FAULT PERSIST?
YES
6 REPLACE ECU (MM49-00-02).
NO
YES
4 DISCONNECT JS15 CONNECTOR AT LOAD COMP CONTROLLER. CHECK FOR 36 (±3) OHMS RESISTANCE BETWEEN LD COMP CONT RECEPTACLE PINS 1 AND 2. ALSO CHECK FOR NO LESS THAN 200 MEGOHMS BETWEEN EACH PIN AND GND. IS TORQUE MOTOR RESISTANCES OK?
6 REPLACE LOAD COMPRESSOR CONTROLLER (MM49-51-03).
2 PERFORM IGV ASSEMBLY ADJ AND TEST PROCEDURES (MM49-51-05). DO IGV OPEN AND CLOSE IN ACCORDANCE WITH CHECKOUT PROCEDURE?
YES
7 REPLACE ECU (MM49-00-02).
NO
8 IF FAULTY, REPLACE LOAD COMPRESSOR CONTROLLER (MM49-51-03) OR IGV FEEDBACK TRANSDUCER (MM49-51-07). IF OK, REPLACE IGV ASSEMBLY (MM49-51-05).

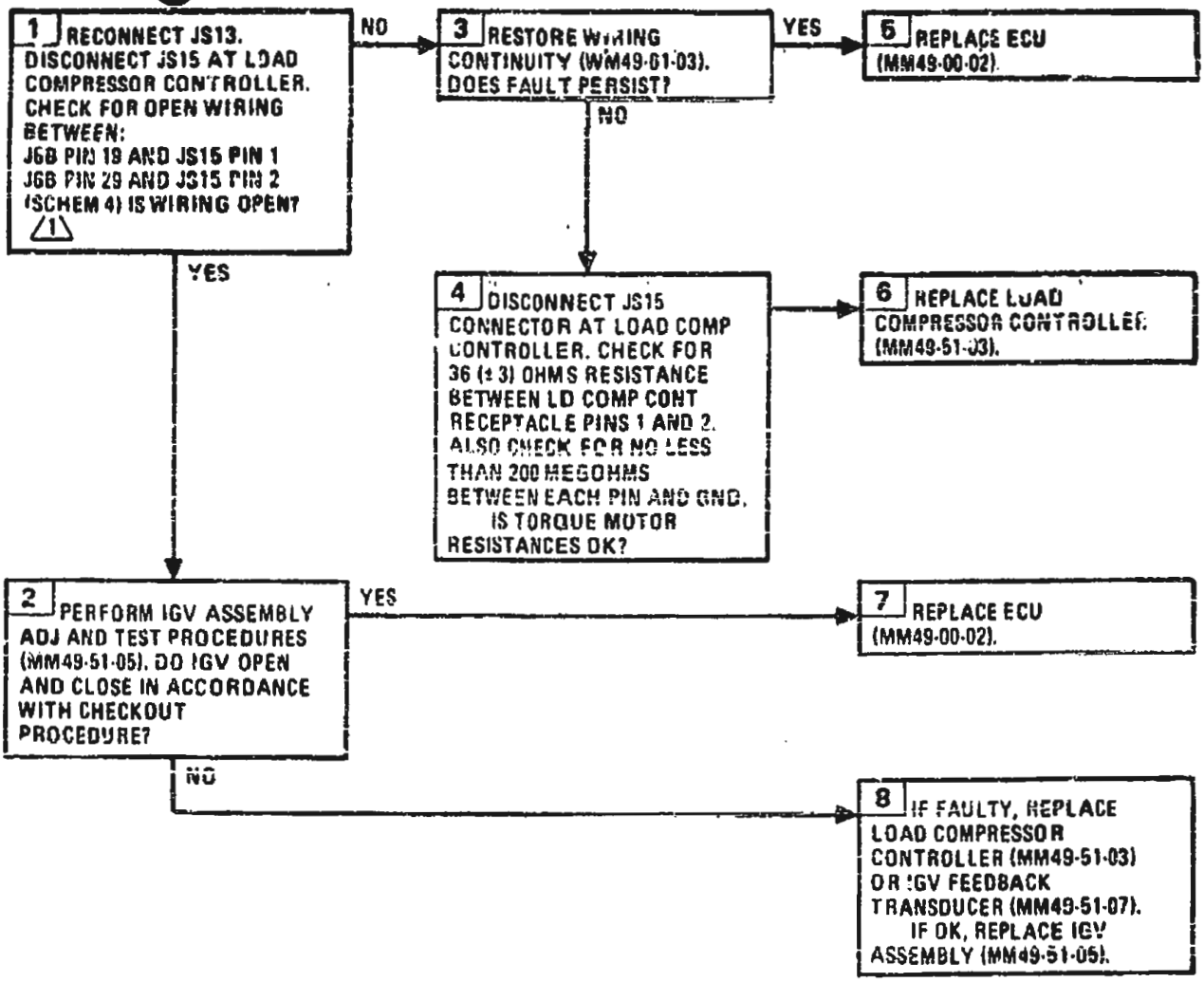
⚠1 **NOTE**
AN OPEN IN EITHER WIRE TO THE LOAD COMP CONTROLLER TORQUE MOTOR WILL CAUSE IGV'S TO GO FULL OPEN TO MAX MODE. A SHORT BETWEEN J6B PIN 29 AND JS15 PIN 2 OR SHORTED TORQUE MOTOR SOLENOID WILL HAVE MOST LIKELY DAMAGED THE APU. IGV'S WILL STILL GO FULL OPEN

M1-0000-49-1055

APU Operates in MAX MODE At All Times
Figure 127 (Sheet 2)

PREREQUISITES
SEE SHEET 1

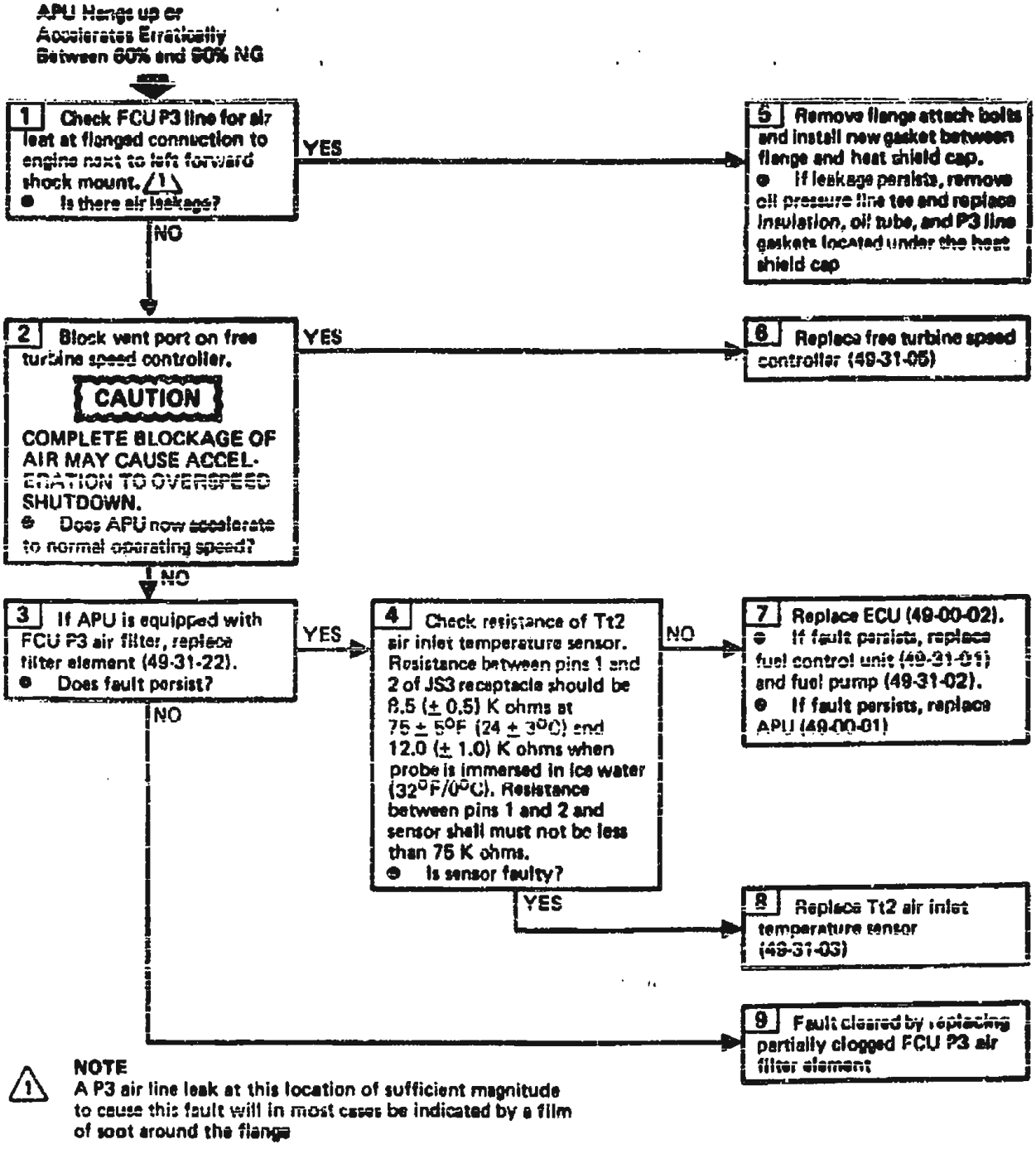
FROM SHEET 1


1 RECONNECT J513. DISCONNECT JS15 AT LOAD COMPRESSOR CONTROLLER. CHECK FOR OPEN WIRING BETWEEN: J6B PIN 19 AND JS15 PIN 1 J6B PIN 29 AND JS15 PIN 2 (SCHEM 4) IS WIRING OPEN? /1\
NO
3 RESTORE WIRING CONTINUITY (WM49-01-03). DOES FAULT PERSIST?
YES
6 REPLACE ECU (MM49-00-02).
NO
YES
4 DISCONNECT JS15 CONNECTOR AT LOAD COMP CONTROLLER. CHECK FOR 36 (±3) OHMS RESISTANCE BETWEEN LD COMP CONT RECEPTACLE PINS 1 AND 2. ALSO CHECK FOR NO LESS THAN 200 MEGOHMS BETWEEN EACH PIN AND GND. IS TORQUE MOTOR RESISTANCES OK?
6 REPLACE LOAD COMPRESSOR CONTROLLER (MM49-51-03).
2 PERFORM IGV ASSEMBLY ADJ AND TEST PROCEDURES (MM49-51-05). DO IGV OPEN AND CLOSE IN ACCORDANCE WITH CHECKOUT PROCEDURE?
YES
7 REPLACE ECU (MM49-00-02).
NO
8 IF FAULTY, REPLACE LOAD COMPRESSOR CONTROLLER (MM49-51-03) OR IGV FEEDBACK TRANSDUCER (MM49-51-07). IF OK, REPLACE IGV ASSEMBLY (MM49-51-05).

/1\ **NOTE**
AN OPEN IN EITHER WIRE TO THE LOAD COMP CONTROLLER TORQUE MOTOR WILL CAUSE IGV'S TO GO FULL OPEN TO MAX MODE. A SHORT BETWEEN J6B PIN 29 AND JS15 PIN 2 WOULD MOST LIKELY HAVE BURNED OUT THE ECU F4 FUSE AND SHUTDOWN THE APU THUS NEGATING THIS CHARTS FAULT SYMPTOM

M1-0000-49-1049

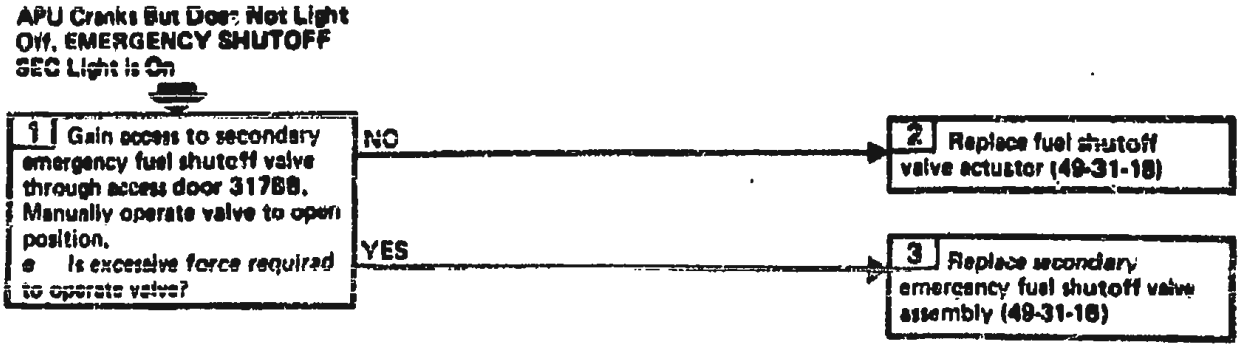
APU Operates in MAX MODE At All Times
Figure 127 (Sheet 2)


APU Hangs up or Accelerates Erratically Between 60% and 90% NG
1 Check FCU P3 line for air leak at flanged connection to engine next to left forward shock mount. (1)
● Is there air leakage?
YES
NO
5 Remove flange attach bolts and install new gasket between flange and heat shield cap.
● If leakage persists, remove oil pressure line tee and replace insulation, oil tube, and P3 line gaskets located under the heat shield cap
2 Block vent port on free turbine speed controller.
CAUTION
COMPLETE BLOCKAGE OF AIR MAY CAUSE ACCELERATION TO OVERSPEED SHUTDOWN.
● Does APU now accelerate to normal operating speed?
YES
6 Replace free turbine speed controller (49-31-05)
NO
3 If APU is equipped with FCU P3 air filter, replace filter element (49-31-22).
● Does fault persist?
YES
4 Check resistance of Tt2 air inlet temperature sensor. Resistance between pins 1 and 2 of JS3 receptacle should be 8.5 (± 0.5) K ohms at 75 ± 5°F (24 ± 3°C) and 12.0 (± 1.0) K ohms when probe is immersed in ice water (32°F/0°C). Resistance between pins 1 and 2 and sensor shell must not be less than 75 K ohms.
● Is sensor faulty?
NO
7 Replace ECU (49-00-02).
● If fault persists, replace fuel control unit (49-31-01) and fuel pump (49-31-02).
● If fault persists, replace APU (49-00-01)
YES
8 Replace Tt2 air inlet temperature sensor (49-31-03)
NO
9 Fault cleared by replacing partially clogged FCU P3 air filter element

(1) **NOTE**
A P3 air line leak at this location of sufficient magnitude to cause this fault will in most cases be indicated by a film of soot around the flange

PREREQUISITES
ECU securely seated in support rack
CB's: CB3-B9 through B17
CB2 C9, C12, C13, C15

APU Hangs Up or Accelerates Erratically Between 60% and 90% Ng
Figure 128

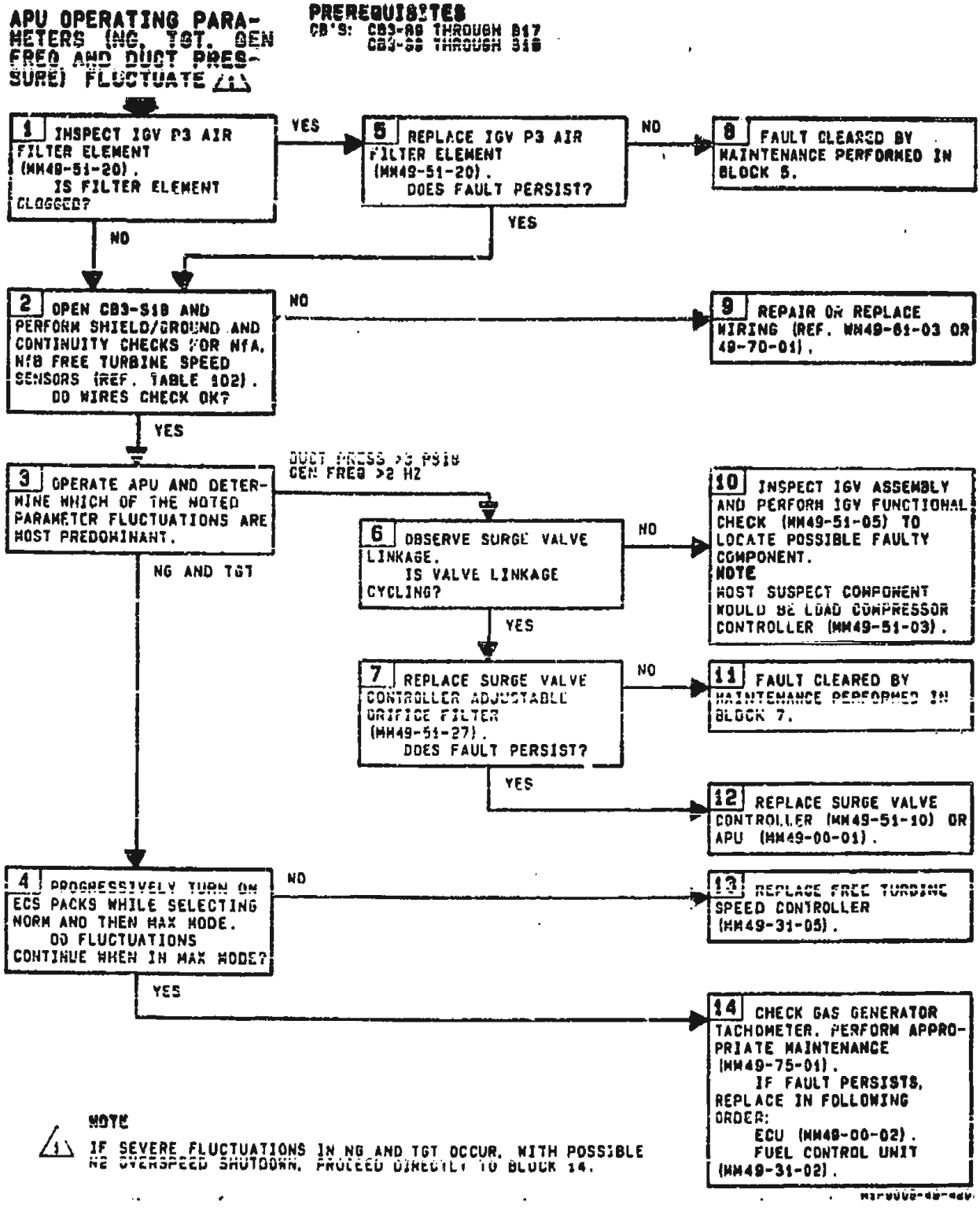

APU Cranks But Does Not Light Off, EMERGENCY SHUTOFF SEC Light is On
1 Gain access to secondary emergency fuel shutoff valve through access door 31788. Manually operate valve to open position.
e Is excessive force required to operate valve?
NO
YES
2 Replace fuel shutoff valve actuator (49-31-18)
3 Replace secondary emergency fuel shutoff valve assembly (49-31-18)

NOTE

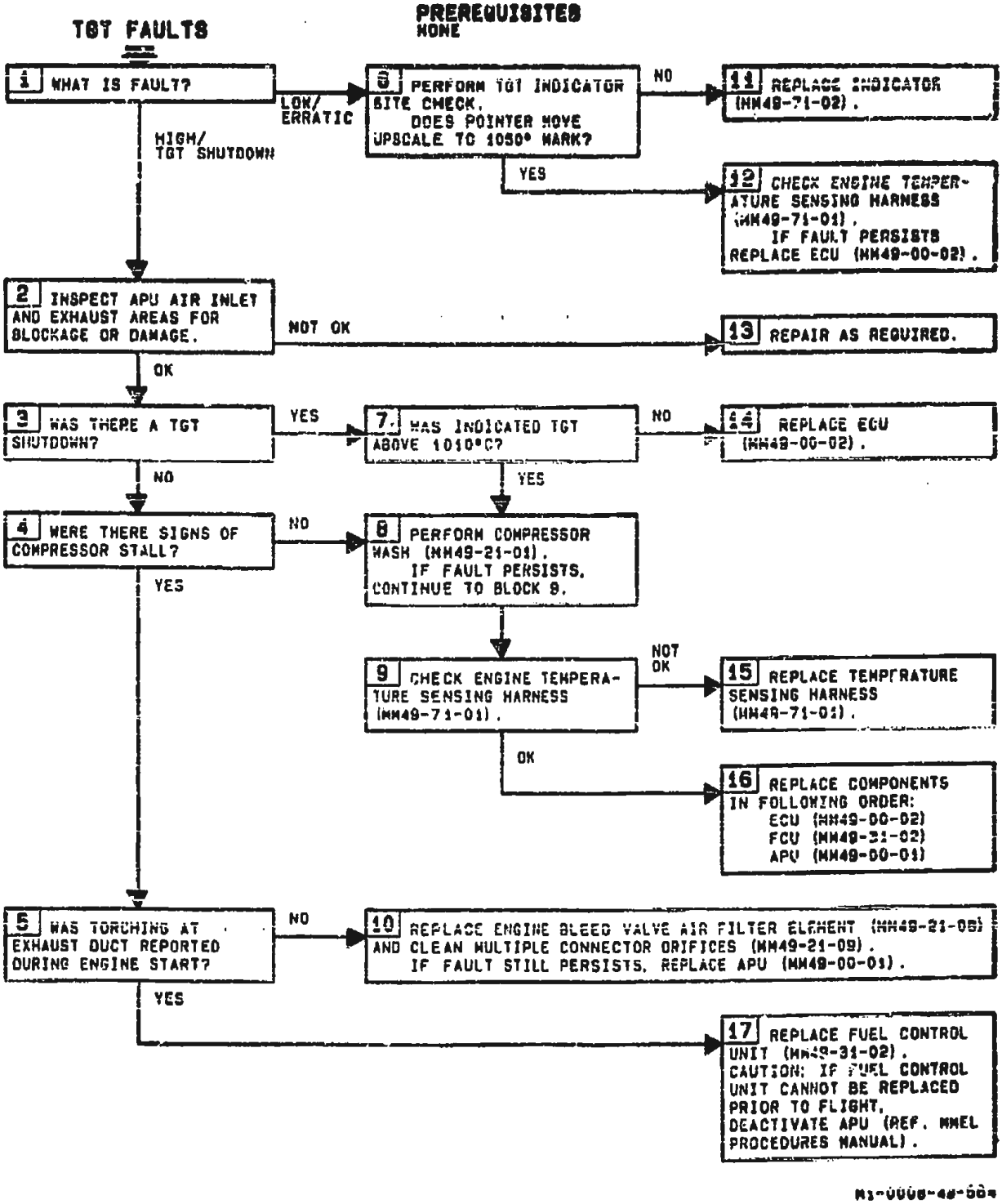
The APU secondary firewall fuel shutoff valve is normally open. Pulling the APU fire handle during ground maintenance closes the valve. If this has been done and the valve was not manually reopened it would be electrically opened when the APU start switch is depressed. The SEC disagreement light would indicate valve opening. If, at this time, the valve does not respond to the open command input, the SEC light would remain on steady and indicate a fail-to-open valve malfunction. This same indication will occur if the valve is commended to the close position and does not respond.

M1-0104-49-211

APU Cranks But Does Not Light Off, EMERGENCY SHUTOFF SEC Light is On
Figure 129


APU OPERATING PARAMETERS (NG, TGT, GEN FREQ AND DUCT PRESSURE) FLUCTUATE ⚠1
PREREQUISITES
CB'S: CB3-A8 THROUGH B17
CB3-S8 THROUGH S18
1 INSPECT IGV P3 AIR FILTER ELEMENT (MM49-51-20). IS FILTER ELEMENT CLOGGED?
YES
5 REPLACE IGV P3 AIR FILTER ELEMENT (MM49-51-20). DOES FAULT PERSIST?
NO
8 FAULT CLEARED BY MAINTENANCE PERFORMED IN BLOCK 5.
YES
NO
2 OPEN CB3-S18 AND PERFORM SHIELD/GROUND AND CONTINUITY CHECKS FOR Nfa, Nf8 FREE TURBINE SPEED SENSORS (REF. TABLE 902). DO WIRES CHECK OK?
NO
9 REPAIR OR REPLACE WIRING (REF. MM49-61-03 OR 49-70-01).
YES
DUCT PRESS >6 PSIG
GEN FREQ >2 HZ
3 OPERATE APU AND DETERMINE WHICH OF THE NOTED PARAMETER FLUCTUATIONS ARE MOST PREDOMINANT.
NG AND TGT
6 OBSERVE SURGE VALVE LINKAGE. IS VALVE LINKAGE CYCLING?
NO
10 INSPECT IGV ASSEMBLY AND PERFORM IGV FUNCTIONAL CHECK (MM49-51-05) TO LOCATE POSSIBLE FAULTY COMPONENT.
NOTE
MOST SUSPECT COMPONENT WOULD BE LOAD COMPRESSOR CONTROLLER (MM49-51-03).
YES
7 REPLACE SURGE VALVE CONTROLLER ADJUSTABLE ORIFICE FILTER (MM49-51-27). DOES FAULT PERSIST?
NO
11 FAULT CLEARED BY MAINTENANCE PERFORMED IN BLOCK 7.
YES
12 REPLACE SURGE VALVE CONTROLLER (MM49-51-10) OR APU (MM49-00-01).
4 PROGRESSIVELY TURN ON ECS PACKS WHILE SELECTING NORM AND THEN MAX MODE. DO FLUCTUATIONS CONTINUE WHEN IN MAX MODE?
NO
13 REPLACE FREE TURBINE SPEED CONTROLLER (MM49-31-05).
YES
14 CHECK GAS GENERATOR TACHOMETER. PERFORM APPROPRIATE MAINTENANCE (MM49-75-01). IF FAULT PERSISTS, REPLACE IN FOLLOWING ORDER: ECU (MM49-00-02). FUEL CONTROL UNIT (MM49-31-02).
⚠1 NOTE
IF SEVERE FLUCTUATIONS IN NG AND TGT OCCUR, WITH POSSIBLE NG OVERSPEED SHUTDOWN, PROCEED DIRECTLY TO BLOCK 14.

APU Operating Parameters (Ng, TGT, Duct Pressure, Gen Freq) Fluctuate
Figure 130

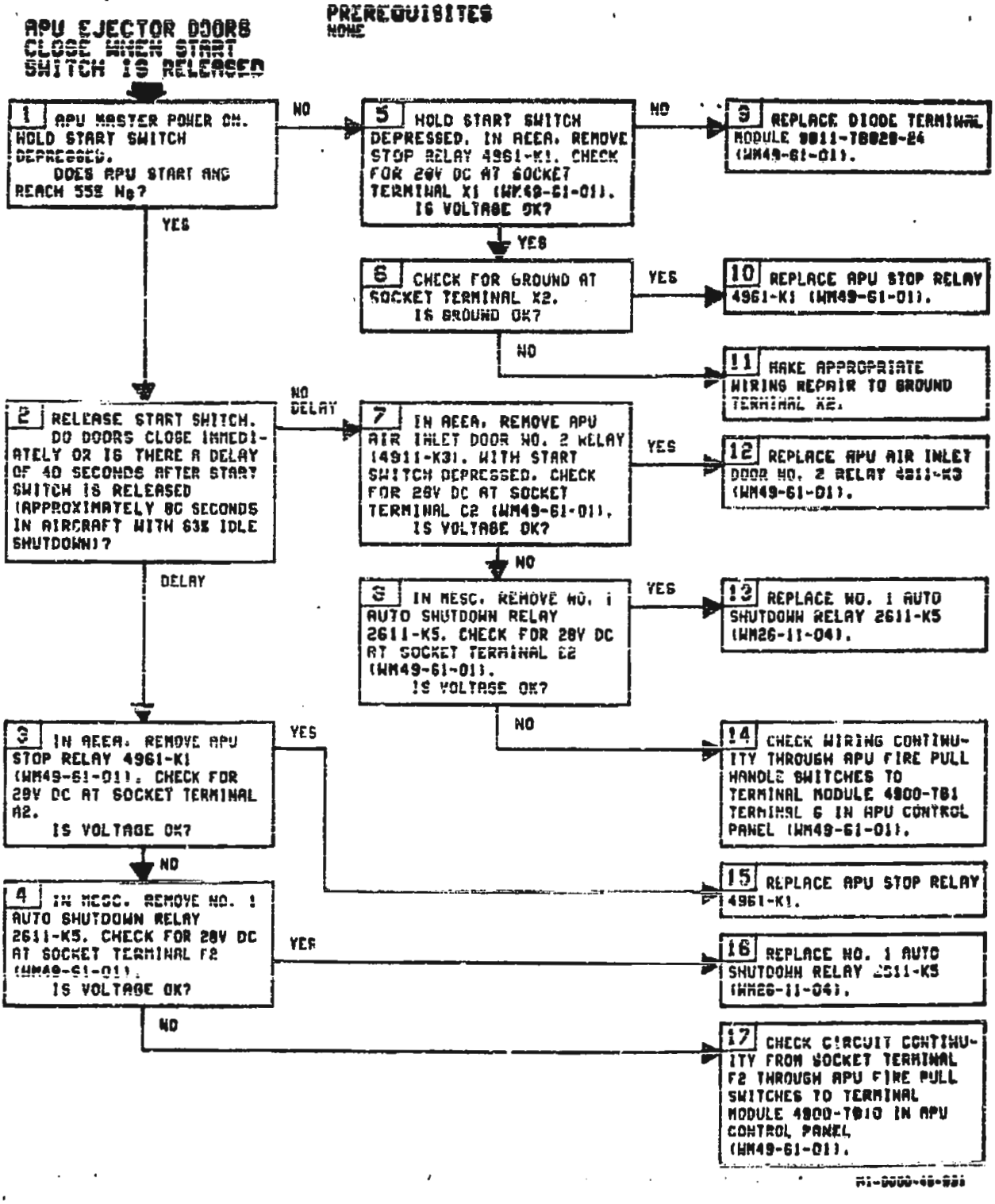

TGT FAULTS
PREREQUISITES
NONE
1 WHAT IS FAULT?
LOW/ ERRATIC
HIGH/ TGT SHUTDOWN
6 PERFORM TGT INDICATOR BITE CHECK. DOES POINTER MOVE UPSCALE TO 1050° MARK?
NO
11 REPLACE INDICATOR (MM49-71-02).
YES
12 CHECK ENGINE TEMPERATURE SENSING HARNESS (MM49-71-01). IF FAULT PERSISTS REPLACE ECU (MM49-00-02).
2 INSPECT APU AIR INLET AND EXHAUST AREAS FOR BLOCKAGE OR DAMAGE.
NOT OK
13 REPAIR AS REQUIRED.
OK
3 WAS THERE A TGT SHUTDOWN?
YES
7 WAS INDICATED TGT ABOVE 1010°C?
NO
14 REPLACE ECU (MM49-00-02).
NO
YES
4 WERE THERE SIGNS OF COMPRESSOR STALL?
NO
8 PERFORM COMPRESSOR WASH (MM49-21-01). IF FAULT PERSISTS, CONTINUE TO BLOCK 9.
YES
9 CHECK ENGINE TEMPERATURE SENSING HARNESS (MM49-71-01).
NOT OK
15 REPLACE TEMPERATURE SENSING HARNESS (MM49-71-01).
OK
16 REPLACE COMPONENTS IN FOLLOWING ORDER: ECU (MM49-00-02) FCU (MM49-31-02) APU (MM49-00-01)
5 WAS TORCHING AT EXHAUST DUCT REPORTED DURING ENGINE START?
NO
10 REPLACE ENGINE BLEED VALVE AIR FILTER ELEMENT (MM49-21-05) AND CLEAN MULTIPLE CONNECTOR ORIFICES (MM49-21-09). IF FAULT STILL PERSISTS, REPLACE APU (MM49-00-01).
YES
17 REPLACE FUEL CONTROL UNIT (MM49-31-02). CAUTION: IF FUEL CONTROL UNIT CANNOT BE REPLACED PRIOR TO FLIGHT, DEACTIVATE APU (REF. MMEL PROCEDURES MANUAL).

M1-0008-49-88A

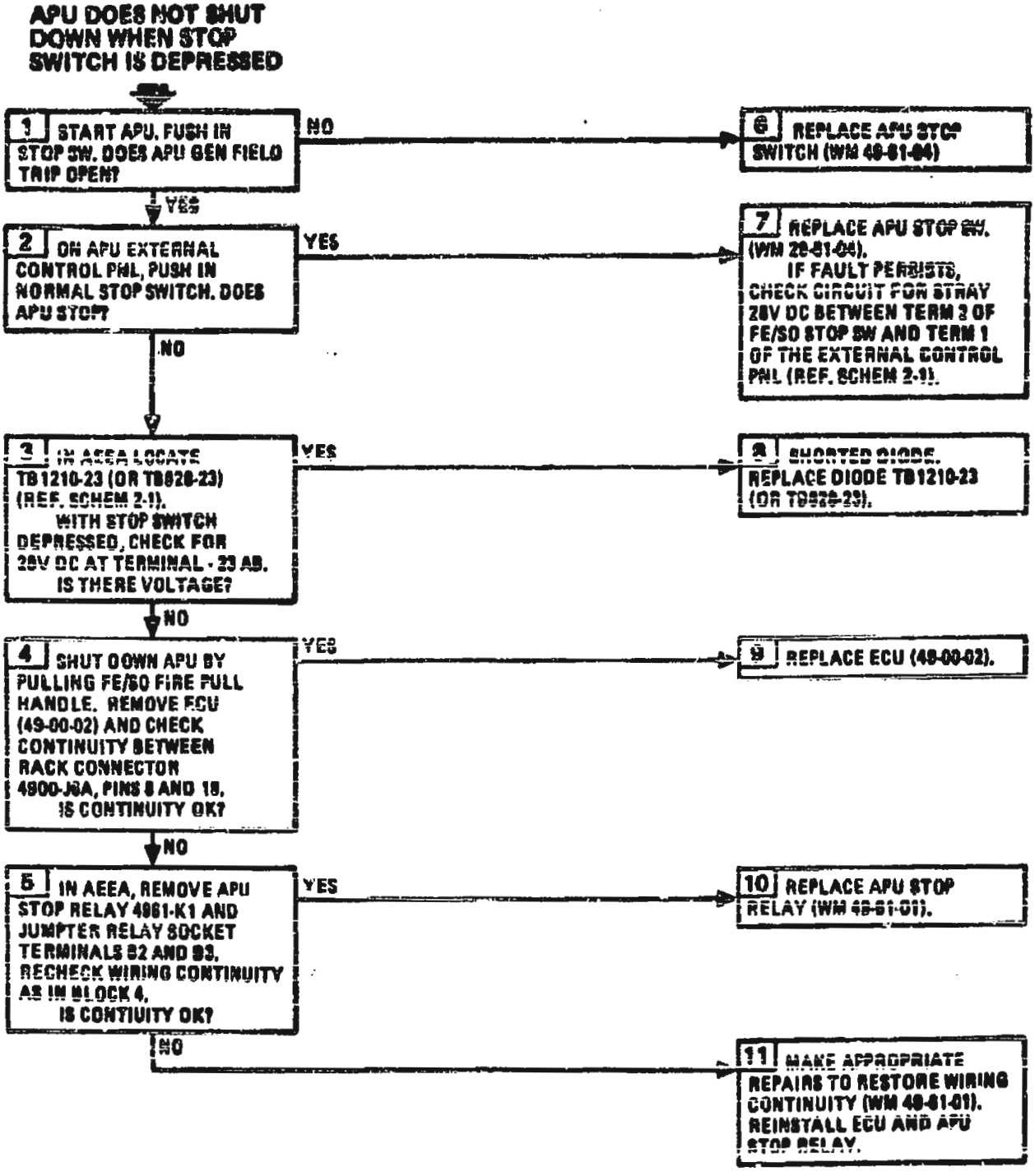
R TGT Faults
R Figure 131

EFFECTIVITY: ALL

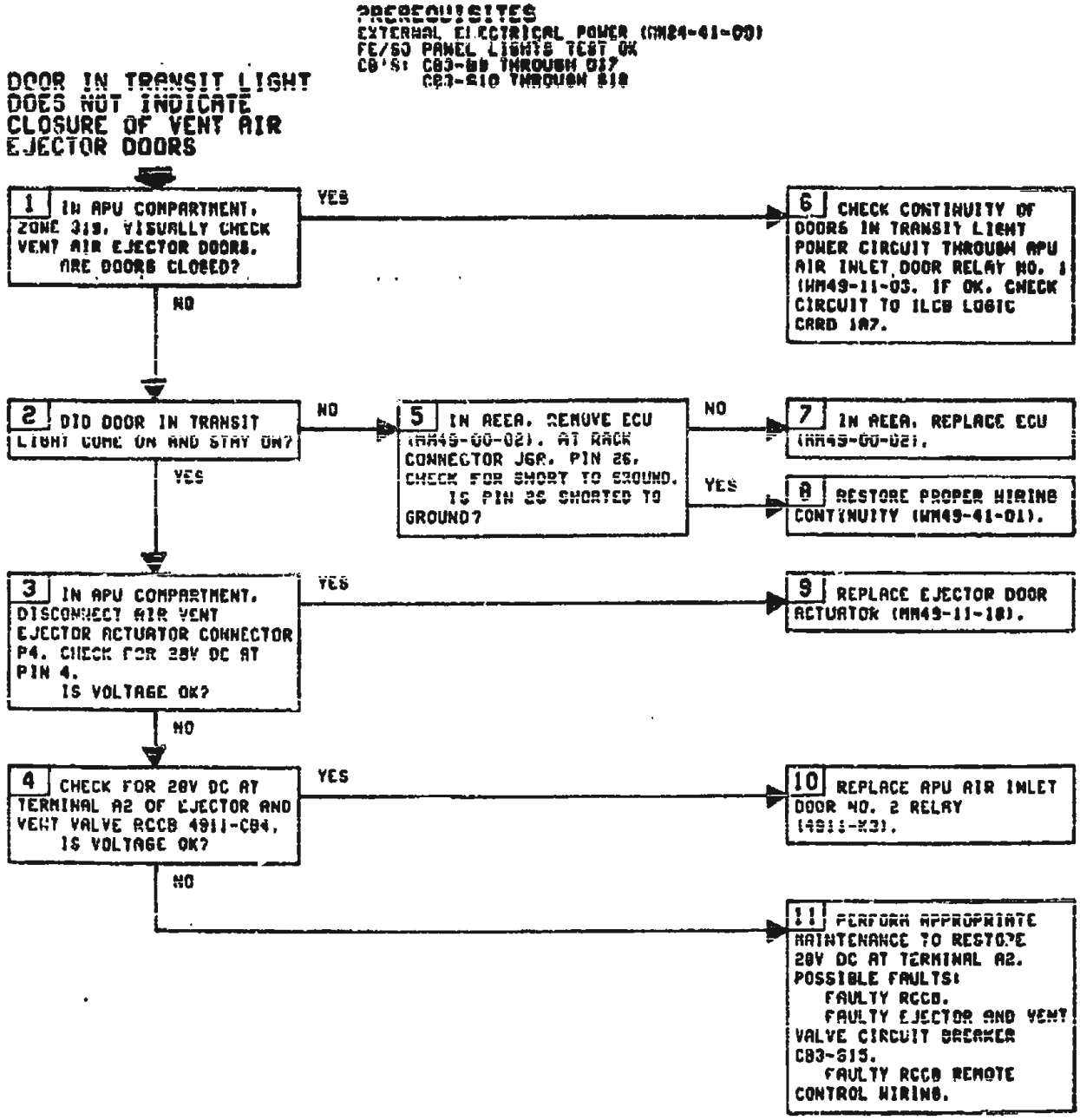
0028


APU EJECTOR DOORS CLOSE WHEN START SWITCH IS RELEASED
PREREQUISITES
NONE
1 APU MASTER POWER ON. HOLD START SWITCH DEPRESSED. DOES APU START AND REACH 55% N8?
NO
5 HOLD START SWITCH DEPRESSED. IN AEEA, REMOVE STOP RELAY 4961-K1. CHECK FOR 28V DC AT SOCKET TERMINAL X1 (WM49-61-01). IS VOLTAGE OK?
NO
9 REPLACE DIODE TERMINAL MODULE 9011-78028-24 (WM49-61-01).
YES
6 CHECK FOR GROUND AT SOCKET TERMINAL X2. IS GROUND OK?
YES
10 REPLACE APU STOP RELAY 4961-K1 (WM49-61-01).
NO
11 MAKE APPROPRIATE WIRING REPAIR TO GROUND TERMINAL X2.
YES
2 RELEASE START SWITCH. DO DOORS CLOSE IMMEDIATELY OR IS THERE A DELAY OF 40 SECONDS AFTER START SWITCH IS RELEASED (APPROXIMATELY 80 SECONDS IN AIRCRAFT WITH 63% IDLE SHUTDOWN)?
NO DELAY
7 IN AEEA, REMOVE APU AIR INLET DOOR NO. 2 RELAY (4911-K3). WITH START SWITCH DEPRESSED. CHECK FOR 28V DC AT SOCKET TERMINAL D2 (WM49-61-01). IS VOLTAGE OK?
YES
12 REPLACE APU AIR INLET DOOR NO. 2 RELAY 4911-K3 (WM49-61-01).
DELAY
NO
8 IN MESC, REMOVE NO. 1 AUTO SHUTDOWN RELAY 2611-K5. CHECK FOR 28V DC AT SOCKET TERMINAL E2 (WM49-61-01). IS VOLTAGE OK?
YES
13 REPLACE NO. 1 AUTO SHUTDOWN RELAY 2611-K5 (WM26-11-04).
NO
14 CHECK WIRING CONTINUITY THROUGH APU FIRE PULL HANDLE SWITCHES TO TERMINAL MODULE 4900-T81 TERMINAL G IN APU CONTROL PANEL (WM49-61-01).
3 IN AEEA, REMOVE APU STOP RELAY 4961-K1 (WM49-61-01). CHECK FOR 28V DC AT SOCKET TERMINAL A2. IS VOLTAGE OK?
YES
15 REPLACE APU STOP RELAY 4961-K1.
NO
4 IN MESC, REMOVE NO. 1 AUTO SHUTDOWN RELAY 2611-K5. CHECK FOR 28V DC AT SOCKET TERMINAL F2 (WM49-61-01). IS VOLTAGE OK?
YES
16 REPLACE NO. 1 AUTO SHUTDOWN RELAY 2611-K5 (WM26-11-04).
NO
17 CHECK CIRCUIT CONTINUITY FROM SOCKET TERMINAL F2 THROUGH APU FIRE PULL SWITCHES TO TERMINAL MODULE 4900-T810 IN APU CONTROL PANEL (WM49-61-01).

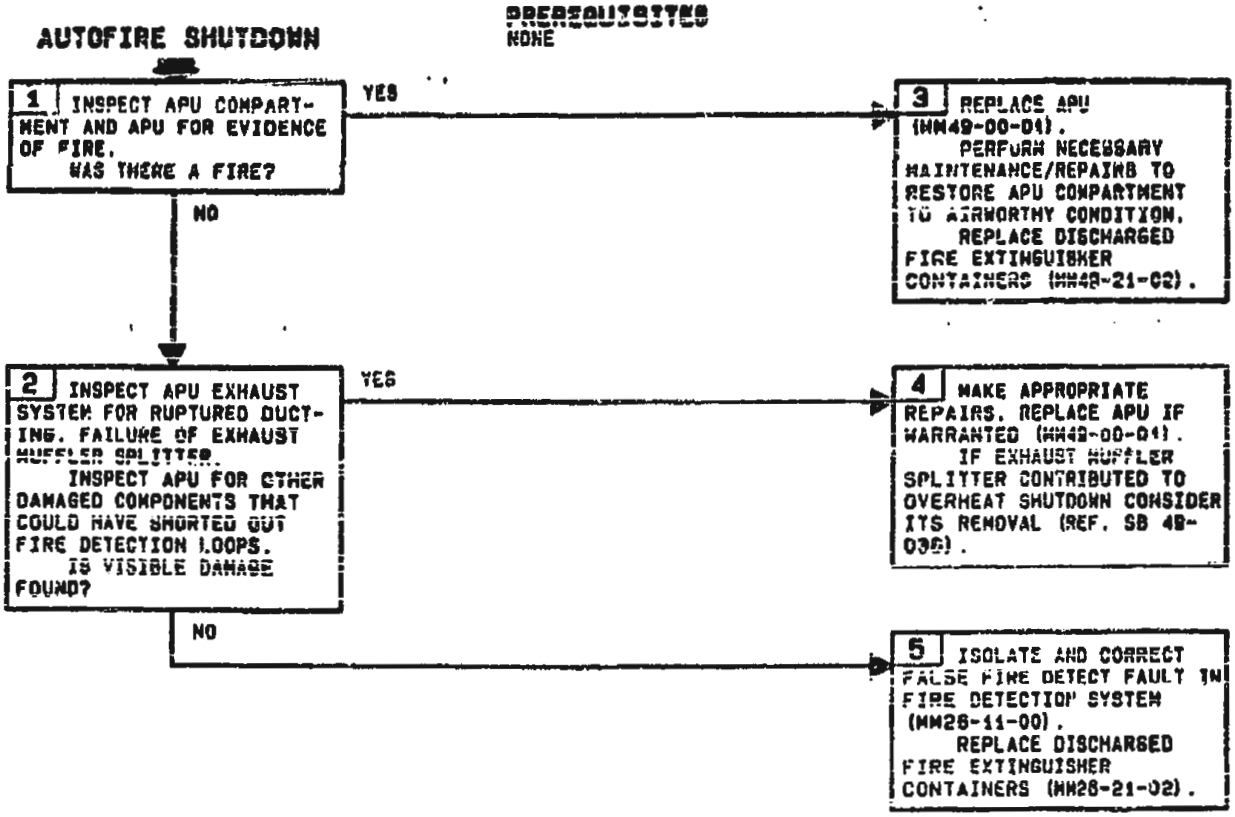
APU Ejector Doors Close When Start Switch Is Released
Figure 132


APU DOES NOT SHUT DOWN WHEN STOP SWITCH IS DEPRESSED
1 START APU. PUSH IN STOP SW. DOES APU GEN FIELD TRIP OPEN?
NO
6 REPLACE APU STOP SWITCH (WM 49-61-04)
YES
2 ON APU EXTERNAL CONTROL PNL, PUSH IN NORMAL STOP SWITCH. DOES APU STOP?
YES
7 REPLACE APU STOP SW. (WM 49-61-04). IF FAULT PERSISTS, CHECK CIRCUIT FOR STRAY 28V DC BETWEEN TERM 3 OF FE/SO STOP SW AND TERM 1 OF THE EXTERNAL CONTROL PNL (REF. SCHEM 2-1).
NO
3 IN AEEA LOCATE TB1210-23 (OR TB828-23) (REF. SCHEM 2-1). WITH STOP SWITCH DEPRESSED, CHECK FOR 28V DC AT TERMINAL - 23 AB. IS THERE VOLTAGE?
YES
8 SHORTED DIODE. REPLACE DIODE TB1210-23 (OR TB828-23).
NO
4 SHUT DOWN APU BY PULLING FE/SO FIRE PULL HANDLE. REMOVE ECU (49-00-02) AND CHECK CONTINUITY BETWEEN RACK CONNECTOR 4900-J6A, PINS 8 AND 18. IS CONTINUITY OK?
YES
9 REPLACE ECU (49-00-02).
NO
5 IN AEEA, REMOVE APU STOP RELAY 4961-K1 AND JUMPTER RELAY SOCKET TERMINALS B2 AND B3. RECHECK WIRING CONTINUITY AS IN BLOCK 4. IS CONTIUITY OK?
YES
10 REPLACE APU STOP RELAY (WM 49-61-01).
NO
11 MAKE APPROPRIATE REPAIRS TO RESTORE WIRING CONTINUITY (WM 49-61-01). REINSTALL ECU AND APU STOP RELAY.
M1-0100-49-491

APU Does Not Shut Down When STOP Switch is Depressed
Figure 133


PREREQUISITES
EXTERNAL ELECTRICAL POWER (MM24-41-00)
FE/SO PANEL LIGHTS TEST OK
CB'S: CB3-B8 THROUGH B17
CB3-C10 THROUGH C18
DOOR IN TRANSIT LIGHT DOES NOT INDICATE CLOSURE OF VENT AIR EJECTOR DOORS
1 IN APU COMPARTMENT, ZONE 318, VISUALLY CHECK VENT AIR EJECTOR DOORS. ARE DOORS CLOSED?
YES
NO
6 CHECK CONTINUITY OF DOORS IN TRANSIT LIGHT POWER CIRCUIT THROUGH APU AIR INLET DOOR RELAY NO. 1 (MM49-11-03. IF OK, CHECK CIRCUIT TO ILCB LOGIC CARD 1A7.
2 DID DOOR IN TRANSIT LIGHT COME ON AND STAY ON?
NO
YES
5 IN AREA, REMOVE ECU (MM49-00-02). AT RACK CONNECTOR J6R, PIN 26, CHECK FOR SHORT TO GROUND. IS PIN 26 SHORTED TO GROUND?
NO
YES
7 IN AREA, REPLACE ECU (MM49-00-02).
8 RESTORE PROPER WIRING CONTINUITY (MM49-41-01).
3 IN APU COMPARTMENT, DISCONNECT AIR VENT EJECTOR ACTUATOR CONNECTOR P4. CHECK FOR 28V DC AT PIN 4. IS VOLTAGE OK?
YES
NO
9 REPLACE EJECTOR DOOR ACTUATOR (MM49-11-18).
4 CHECK FOR 28V DC AT TERMINAL A2 OF EJECTOR AND VENT VALVE RCCB 4911-CB4. IS VOLTAGE OK?
YES
NO
10 REPLACE APU AIR INLET DOOR NO. 2 RELAY (4911-K3).
11 PERFORM APPROPRIATE MAINTENANCE TO RESTORE 28V DC AT TERMINAL A2. POSSIBLE FAULTS:
FAULTY RCCB.
FAULTY EJECTOR AND VENT VALVE CIRCUIT BREAKER CB3-C15.
FAULTY RCCB REMOTE CONTROL WIRING.

DOOR IN TRANSIT Light Does Not Indicate Closure of Vent Air Ejector Doors
Figure 134


AUTOFIRE SHUTDOWN
PREREQUISITES:
NONE
1 INSPECT APU COMPARTMENT AND APU FOR EVIDENCE OF FIRE.
WAS THERE A FIRE?
YES
NO
3 REPLACE APU (HM49-00-01).
PERFORM NECESSARY MAINTENANCE/REPAIRS TO RESTORE APU COMPARTMENT TO AIRWORTHY CONDITION.
REPLACE DISCHARGED FIRE EXTINGUISHER CONTAINERS (HM48-21-02).
2 INSPECT APU EXHAUST SYSTEM FOR RUPTURED DUCTING. FAILURE OF EXHAUST MUFFLER SPLITTER.
INSPECT APU FOR OTHER DAMAGED COMPONENTS THAT COULD HAVE SHORTED OUT FIRE DETECTION LOOPS.
IS VISIBLE DAMAGE FOUND?
YES
4 MAKE APPROPRIATE REPAIRS. REPLACE APU IF WARRANTED (HM49-00-01).
IF EXHAUST MUFFLER SPLITTER CONTRIBUTED TO OVERHEAT SHUTDOWN CONSIDER ITS REMOVAL (REF. SB 49-036).
NO
5 ISOLATE AND CORRECT FALSE FIRE DETECT FAULT IN FIRE DETECTION SYSTEM (HM26-11-00).
REPLACE DISCHARGED FIRE EXTINGUISHER CONTAINERS (HM26-21-02).

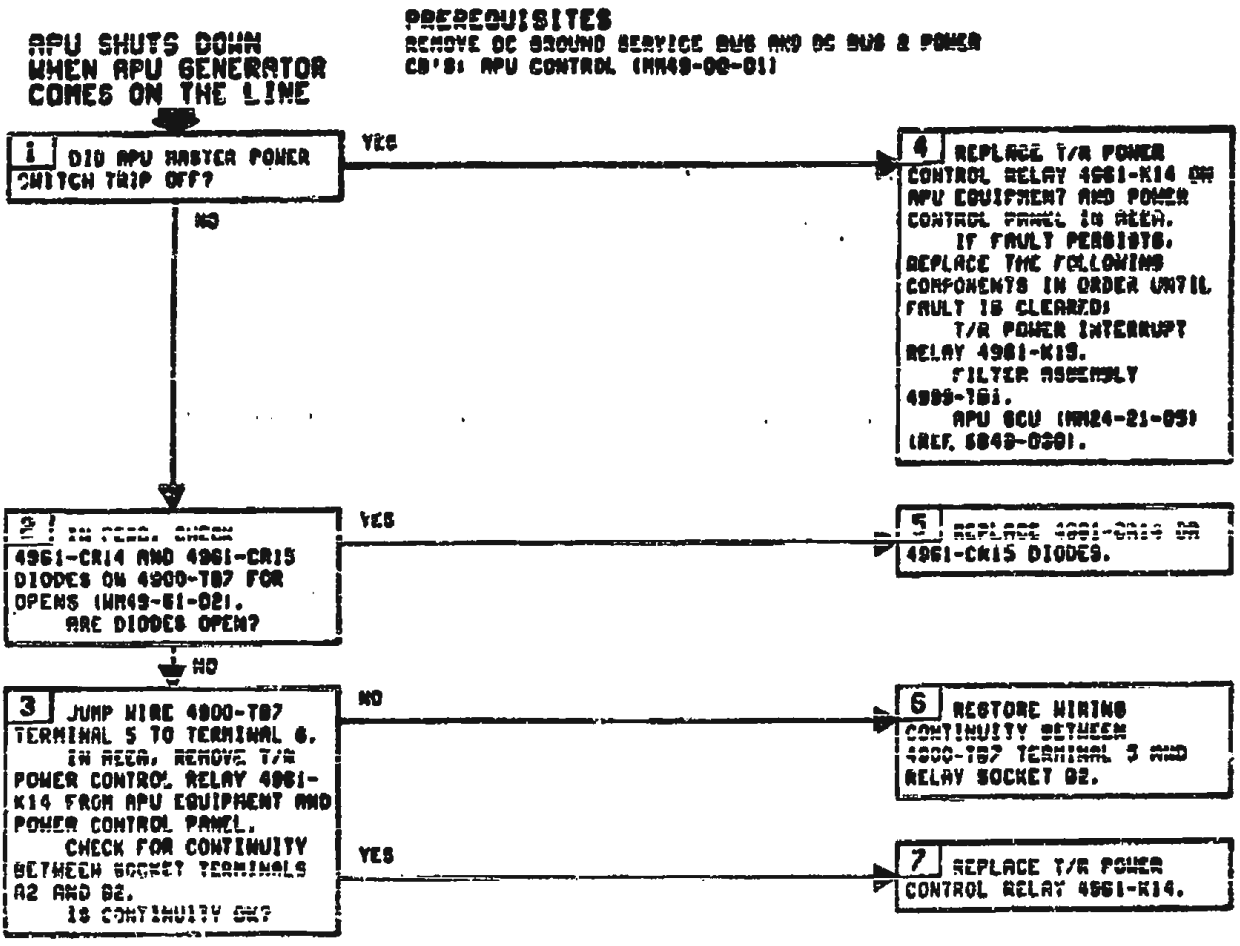
M1-0001-49-880

R
R

Autofire Shutdown
Figure 135

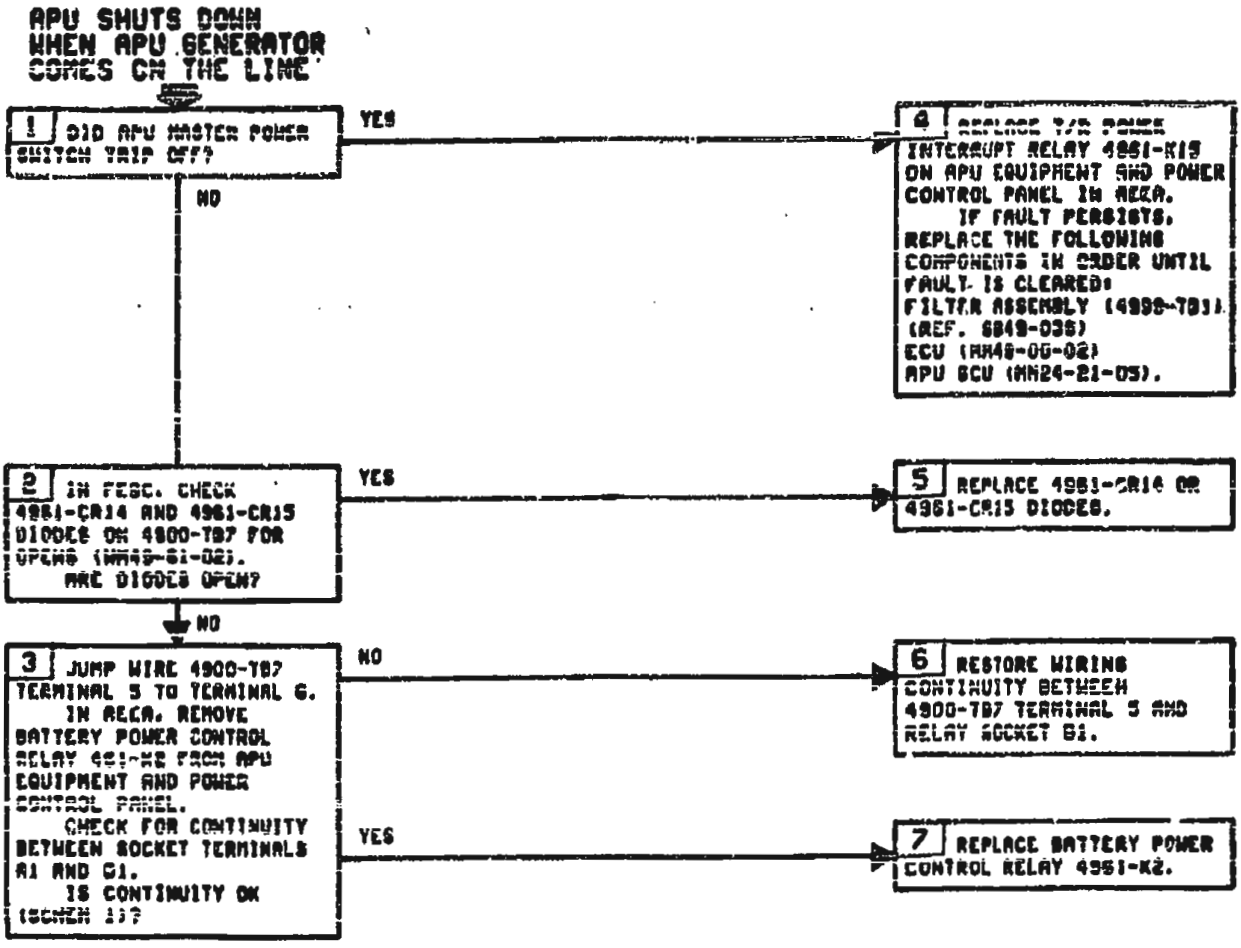
EFFECTIVITY: ALL

0028


APU SHUTS DOWN WHEN APU GENERATOR COMES ON THE LINE
PREREQUISITES
REMOVE DC GROUND SERVICE BUS AND DC BUS A POWER CB'S: APU CONTROL (WM49-00-01)
1 DID APU MASTER POWER SWITCH TRIP OFF?
YES
NO
4 REPLACE T/R POWER CONTROL RELAY 4961-K14 ON APU EQUIPMENT AND POWER CONTROL PANEL IN BAY. IF FAULT PERSISTS, REPLACE THE FOLLOWING COMPONENTS IN ORDER UNTIL FAULT IS CLEARED: T/R POWER INTERRUPT RELAY 4961-K13. FILTER ASSEMBLY 4999-7B1. APU GCU (WM24-21-05) (REF. 5049-0301).
2 IN BAY, CHECK 4961-CR14 AND 4961-CR15 DIODES ON 4900-7B7 FOR OPENS (WM49-61-02). ARE DIODES OPEN?
YES
5 REPLACE 4961-CR14 OR 4961-CR15 DIODES.
NO
3 JUMP WIRE 4900-7B7 TERMINAL 5 TO TERMINAL 6. IN BAY, REMOVE T/R POWER CONTROL RELAY 4961-K14 FROM APU EQUIPMENT AND POWER CONTROL PANEL. CHECK FOR CONTINUITY BETWEEN SOCKET TERMINALS A2 AND B2. IS CONTINUITY OK?
NO
6 RESTORE WIRING CONTINUITY BETWEEN 4900-7B7 TERMINAL 5 AND RELAY SOCKET B2.
YES
7 REPLACE T/R POWER CONTROL RELAY 4961-K14.

APU Shuts Down When APU Generator Comes On The Line
Figure 136

PREREQUISITES
REMOVE DC GROUND SERVICE BUS
AND DC BUS 2 POWER
CB'S: APU CONTROL (MM49-00-01)

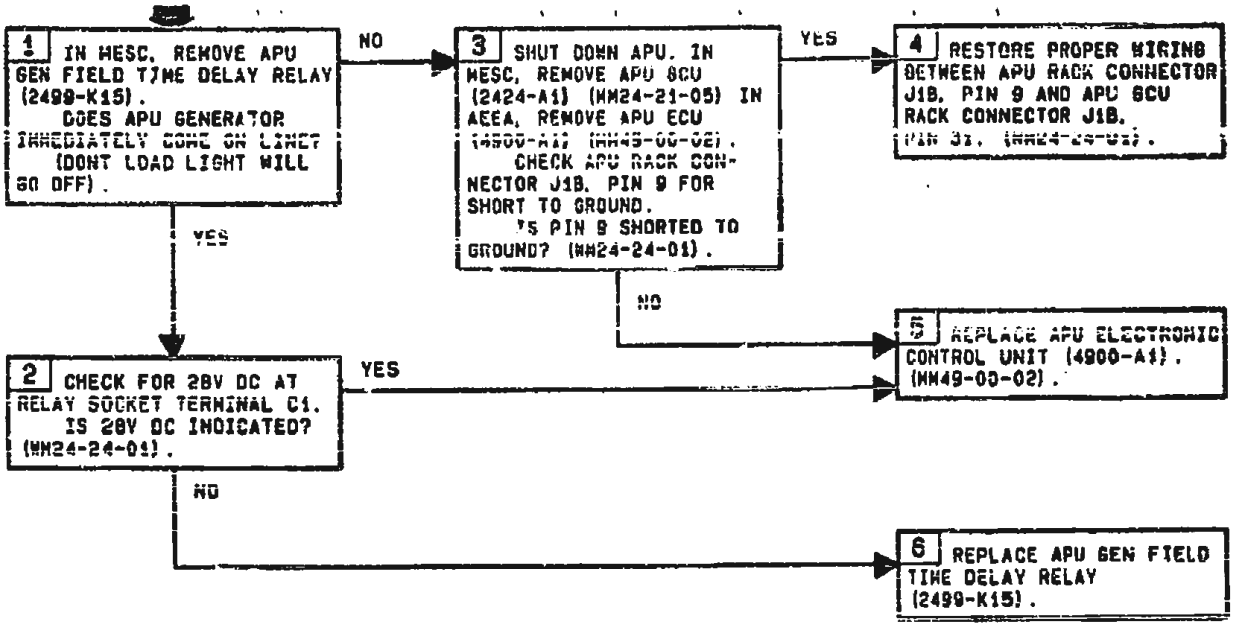

APU SHUTS DOWN WHEN APU GENERATOR COMES ON THE LINE
1 DID APU MASTER POWER SWITCH TRIP OFF?
YES
NO
4 REPLACE T/R POWER INTERRUPT RELAY 4951-K19 ON APU EQUIPMENT AND POWER CONTROL PANEL IN AECA. IF FAULT PERSISTS, REPLACE THE FOLLOWING COMPONENTS IN ORDER UNTIL FAULT IS CLEARED: FILTER ASSEMBLY (4900-701) (REF. 5849-036) ECU (MM49-00-02) APU GCU (MM24-21-05).
2 IN FEGC, CHECK 4951-CR14 AND 4951-CR15 DIODES ON 4900-707 FOR OPENS (MM49-61-02). ARE DIODES OPEN?
YES
5 REPLACE 4951-CR14 OR 4951-CR15 DIODES.
NO
3 JUMP WIRE 4900-707 TERMINAL 5 TO TERMINAL 6. IN AECA, REMOVE BATTERY POWER CONTROL RELAY 4951-K2 FROM APU EQUIPMENT AND POWER CONTROL PANEL. CHECK FOR CONTINUITY BETWEEN SOCKET TERMINALS A1 AND G1. IS CONTINUITY OK (OHMS)?
NO
6 RESTORE WIRING CONTINUITY BETWEEN 4900-707 TERMINAL 5 AND RELAY SOCKET G1.
YES
7 REPLACE BATTERY POWER CONTROL RELAY 4951-K2.

APU Shuts Down When APU Generator Comes On The Line
Figure 136

PREREQUISITES

EXTERNAL ELECTRICAL POWER OFF (MM24-41-00)
CB'S: CB1-B9 THROUGH B17
CB3-S9 THROUGH S18.
APU RUNNING AND STABILIZED ABOVE 95% Nn.

APU GENERATOR DOES NOT COME ON LINE; DONT LOAD LIGHT ON

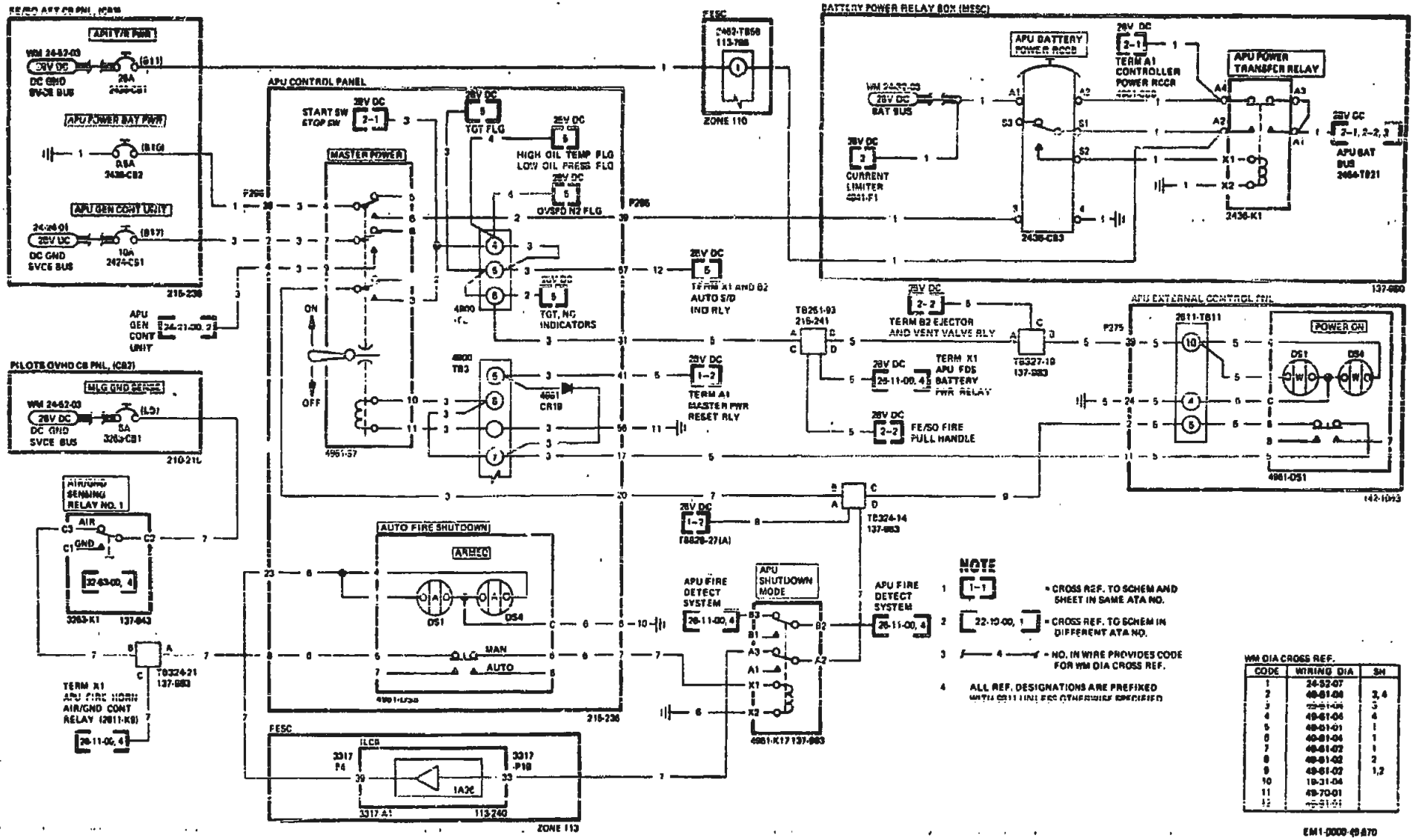

1 IN MESC, REMOVE APU GEN FIELD TIME DELAY RELAY (2499-K15). DOES APU GENERATOR IMMEDIATELY COME ON LINE? (DONT LOAD LIGHT WILL GO OFF).
NO
3 SHUT DOWN APU. IN MESC, REMOVE APU ECU (2424-A1) (MM24-21-05) IN AEEA, REMOVE APU ECU (4500-A1) (MM49-00-02). CHECK APU RACK CONNECTOR J1B, PIN 9 FOR SHORT TO GROUND. IS PIN 9 SHORTED TO GROUND? (MM24-24-01).
YES
4 RESTORE PROPER WIRING BETWEEN APU RACK CONNECTOR J1B, PIN 9 AND APU ECU RACK CONNECTOR J1B, PIN 31. (MM24-24-01).
YES
2 CHECK FOR 28V DC AT RELAY SOCKET TERMINAL C1. IS 28V DC INDICATED? (MM24-24-01).
NO
5 REPLACE APU ELECTRONIC CONTROL UNIT (4900-A1). (MM49-00-02).
6 REPLACE APU GEN FIELD TIME DELAY RELAY (2499-K15).

M1-0001-49-038

R APU Generator Does Not Come On Line; DONT LOAD Light On
R Figure 137

EFFECTIVITY: ALL

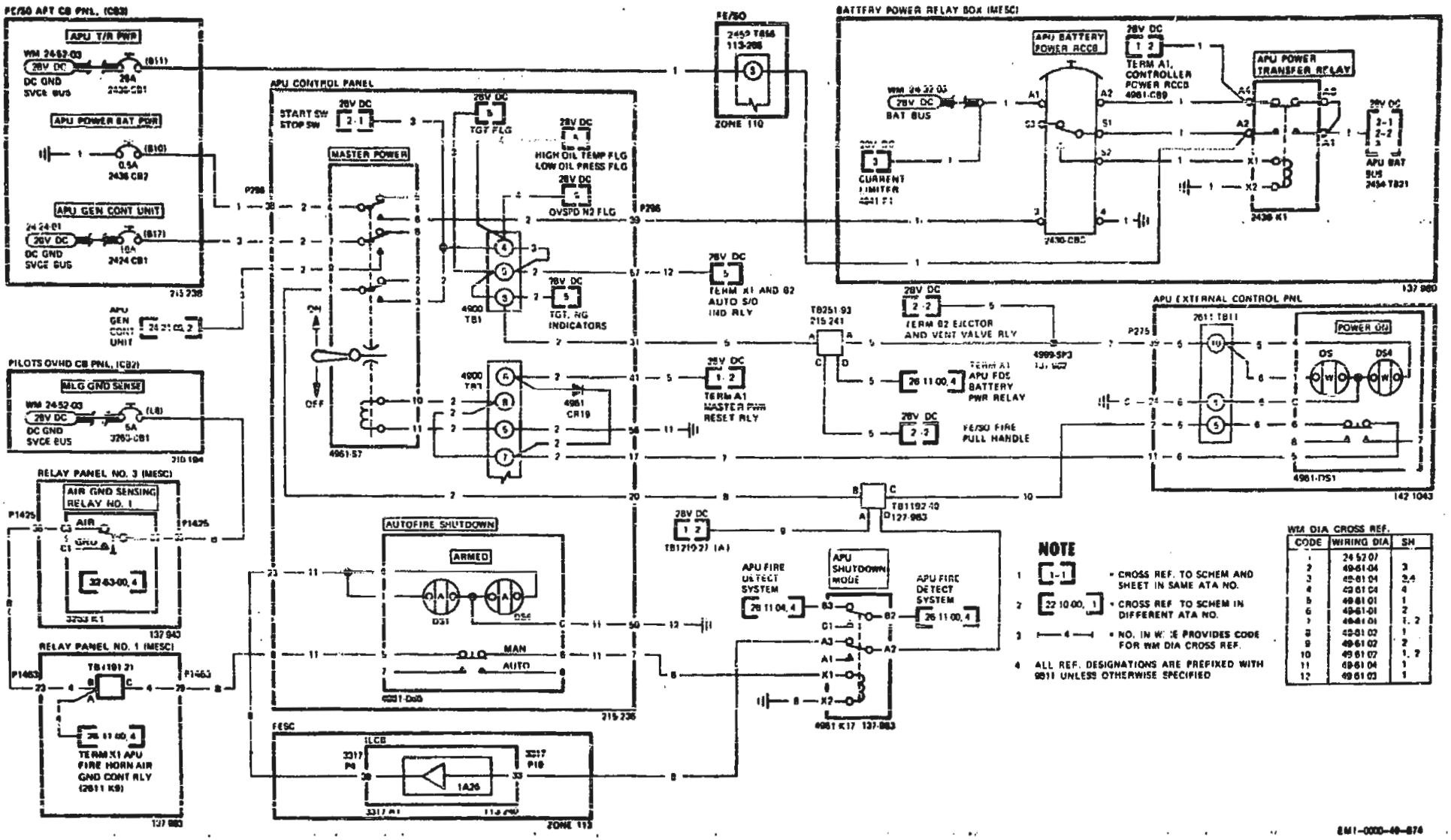
002B


APU CONTROL PANEL
BATTERY POWER RELAY BOX (MESC)
APU BATTERY POWER RCCB
APU POWER TRANSFER RELAY
APU EXTERNAL CONTROL PNL
POWER ON
MASTER POWER
AUTO FIRE SHUTDOWN
APU SHUTDOWN MODE
APU FIRE DETECT SYSTEM
FESC
ZONE 110
ZONE 113
TERM A1 CONTROLLER POWER RCCB
TERM B2 EJECTOR AND VENT VALVE RLY
TERM X1 APU FDS BATTERY PWR RELAY
FE/SO FIRE PULL HANDLE
TERM A1 MASTER PWR RESET RLY
TERM X1 AND B2 AUTO S/D IND RLY
TGT, NC INDICATORS
HIGH OIL TEMP FLG
LOW OIL PRESS FLG
OVSPD N2 FLG
TGT FLG
START SW
APU GEN CONT UNIT
CURRENT LIMITER
TERM X1 APU FIRE HORN AIR/GND CONT RELAY (2811-K8)
HI/GND SENSING RELAY NO. 1
NOTE
1 = CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
2 = CROSS REF. TO SCHEM IN DIFFERENT ATA NO.
3 = NO. IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
4 ALL REF. DESIGNATIONS ARE PREFIXED
WM DIA CROSS REF.
CODE | WIRING DIA | SH
1 | 24-52-07
2 | 49-61-06 | 3,4
4 | 49-61-06 | 4
5 | 49-61-01 | 1
6 | 49-61-04 | 1
7 | 49-61-02 | 1
8 | 49-61-02 | 2
9 | 49-61-02 | 1,2
10 | 19-31-04
11 | 49-70-01

APU Power Distribution Circuits
SCHEM 1 (Sheet 1)

R
R
002B

EFFECTIVITY: 001-023



NOTE

1. [1-1] * CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
2. [22 10 00, 1] * CROSS REF. TO SCHEM IN DIFFERENT ATA NO.
3. [—4—] * NO. IN W. DIA PROVIDES CODE FOR WM DIA CROSS REF.
4. ALL REF. DESIGNATIONS ARE PREFIXED WITH 9811 UNLESS OTHERWISE SPECIFIED

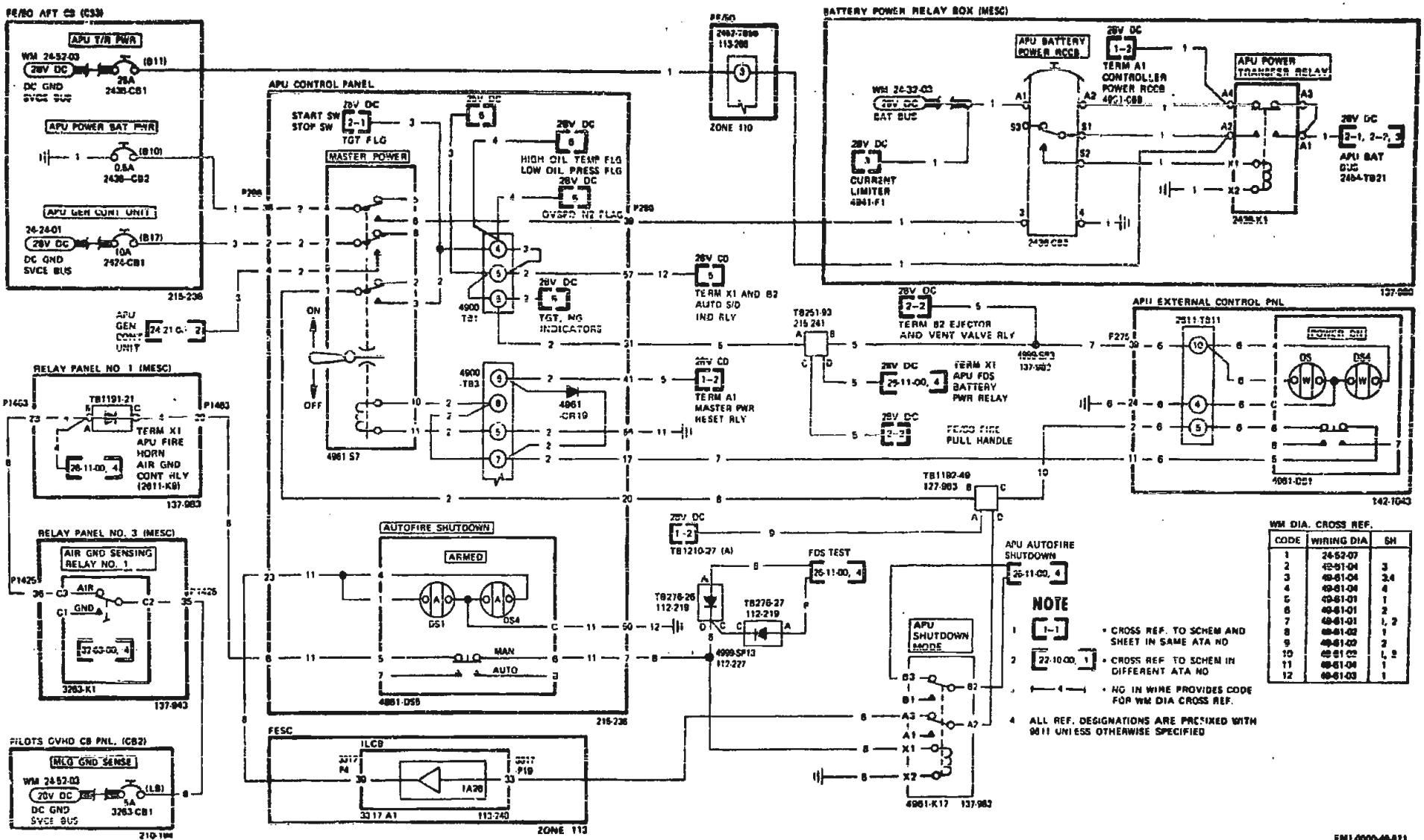
WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	24 52 07	
2	49-61-04	3
3	49-61-04	3,4
4	49-61-04	4
5	49-61-01	1
6	49-61-01	2
7	49-61-01	1, 2
8	49-61-02	1
9	49-61-02	2
10	49-61-07	1, 2
11	49-61-04	1
12	49-61-03	1

EMI-0000-49-874

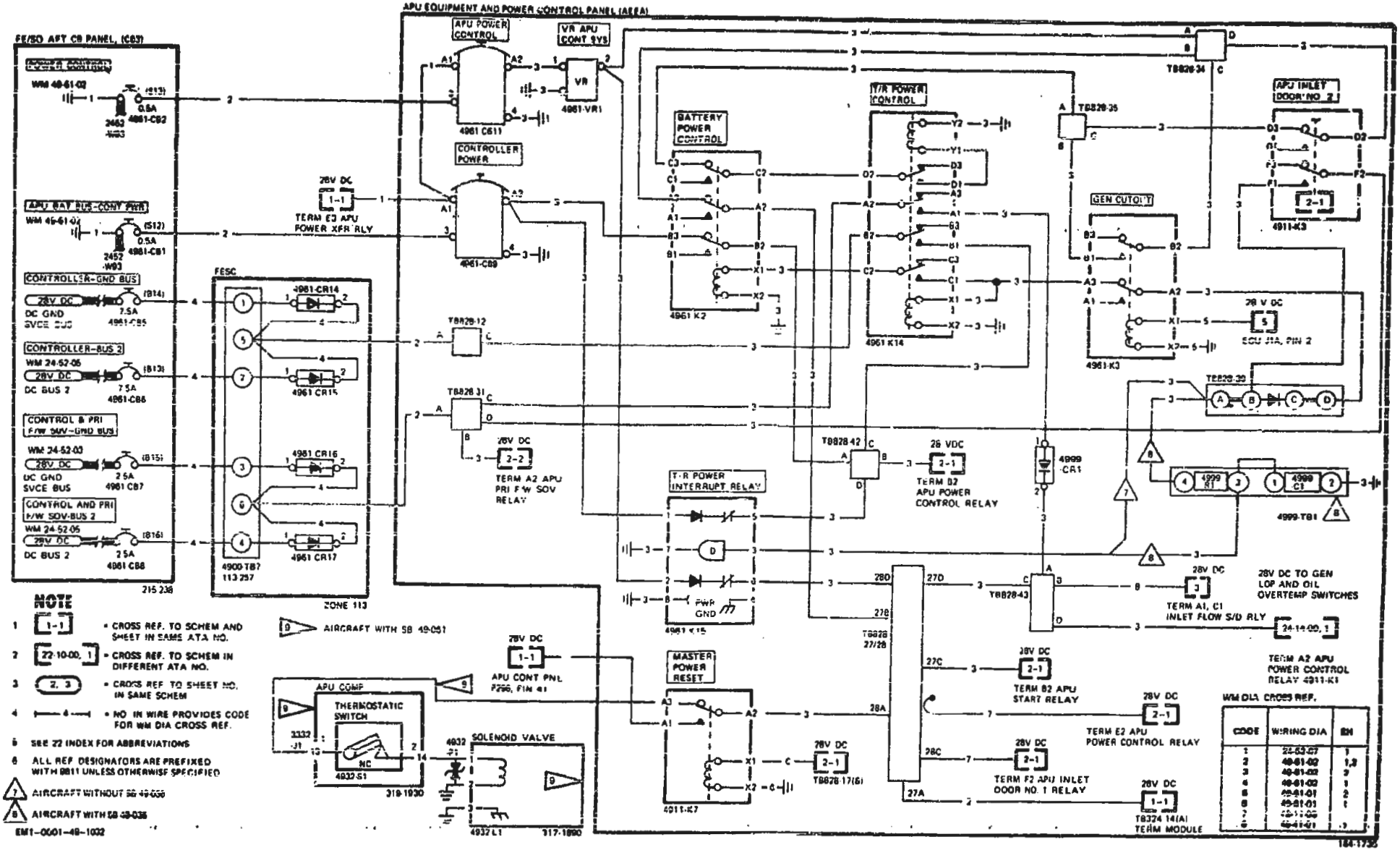
APU Power Distribution Circuits
SCHEM 1 (Sheet 1)

R EFFECTIVITY: 024-028
R
0028


APU T/R PWR
APU POWER BAT PWR
APU GEN CONT UNIT
APU CONTROL PANEL
MASTER POWER
START SW
STOP SW
TGT FLG
HIGH OIL TEMP FLG
LOW OIL PRESS FLG
OVSPD N2 FLAG
TGT, NG INDICATORS
TERM X1 AND B2 AUTO S/D IND RLY
TERM A1 MASTER PWR RESET RLY
TERM B2 EJECTOR AND VENT VALVE RLY
TERM X1 APU FDS BATTERY PWR RELAY
FE/BD FIRE PULL HANDLE
BATTERY POWER RELAY BOX (MESC)
APU BATTERY POWER RCCB
TERM A1 CONTROLLER POWER RCCB
APU POWER TRANSFER RELAY
CURRENT LIMITER
BAT BUS
APU BAT BUS
APU EXTERNAL CONTROL PNL
RELAY PANEL NO. 1 (MESC)
TERM X1 APU FIRE HORN AIR GND CONT RLY
RELAY PANEL NO. 3 (MESC)
AIR GND SENSING RELAY NO. 1
AUTOFIRE SHUTDOWN
ARMED
MAN
AUTO
FDS TEST
APU AUTOFIRE SHUTDOWN
APU SHUTDOWN MODE
PILOTS OVHD CB PNL. (CB2)
MLG GND SENSE
FESC
ILCB
ZONE 110
ZONE 113
NOTE
1 CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO
2 CROSS REF. TO SCHEM IN DIFFERENT ATA NO
3 NO IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
4 ALL REF. DESIGNATIONS ARE PREFIXED WITH 9811 UNLESS OTHERWISE SPECIFIED
WM DIA. CROSS REF.
CODE | WIRING DIA | SH
1 | 24-52-07
2 | 49-61-04 | 3
3 | 49-61-04 | 3,4
4 | 49-61-04 | 4
5 | 49-61-01 | 1
6 | 49-61-01 | 2
7 | 49-61-01 | 1, 2
8 | 49-61-02 | 1
9 | 49-61-02 | 2
10 | 49-61-02 | 1, 2
11 | 49-61-04 | 1
12 | 49-61-03 | 1

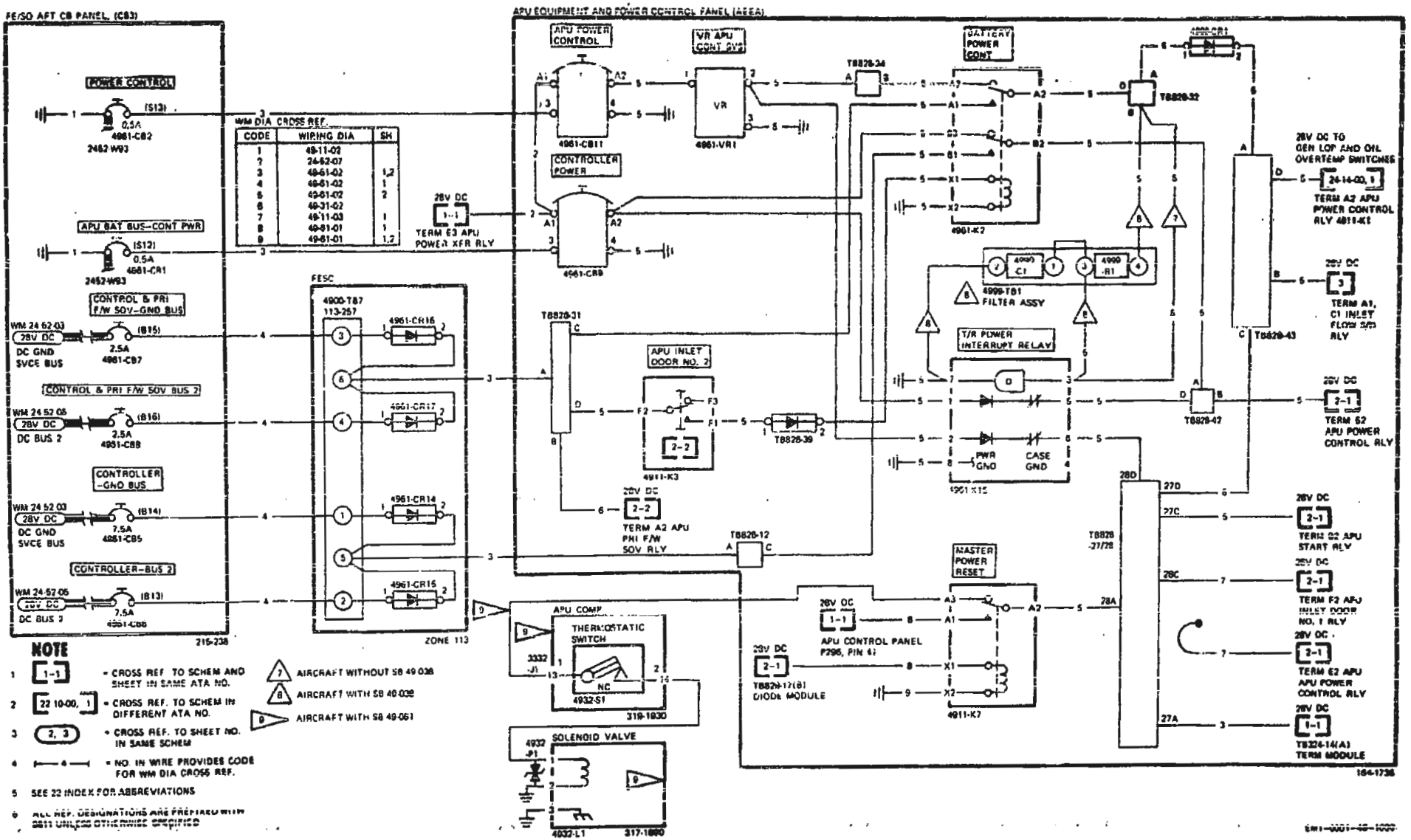
APU Power Distribution Circuits
SCHEM 1 (Sheet 1)

R EFFECTIVITY: 029-036
R
002B



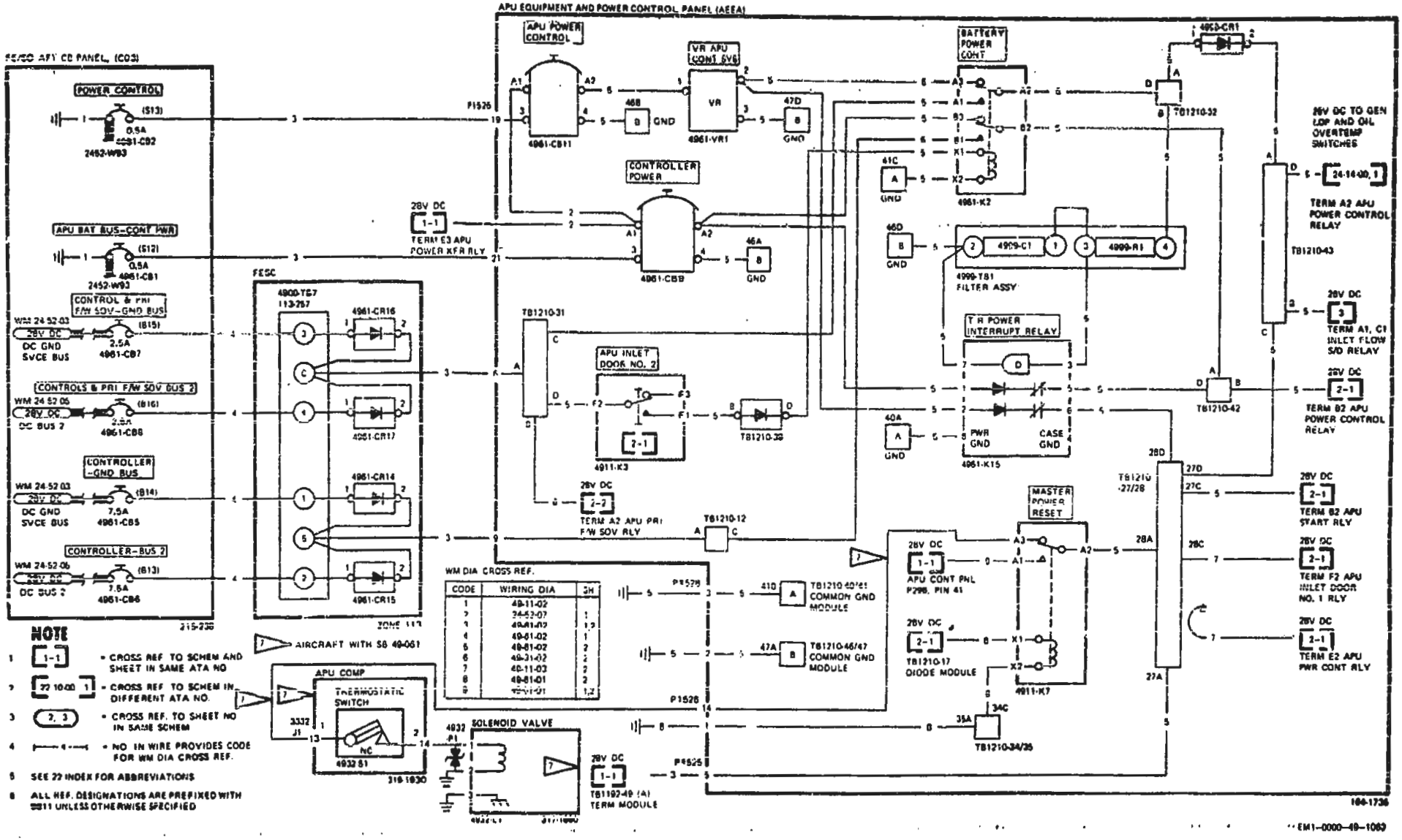
APU Power Distribution Circuits
SCHEM 1 (Sheet 2)

R EFFECTIVITY: 001-014
R
002B


FE/SO AFT CB PANEL (CB3)
APU EQUIPMENT AND POWER CONTROL PANEL (AEEA)
POWER CONTROL
APU BAT BUS-CONT PWR
CONTROL & PRI F/W SOV-GND BUS
CONTROL & PRI F/W SOV BUS 2
CONTROLLER -GND BUS
CONTROLLER-BUS 2
APU POWER CONTROL
VR APU CONT PWR
CONTROLLER POWER
BATTERY POWER CONT
APU INLET DOOR NO. 2
T/R POWER INTERRUPT RELAY
MASTER POWER RESET
APU CONTROL PANEL P296, PIN 41
TERM E3 APU POWER XFR RLY
TERM A2 APU PRI F/W SOV RLY
TERM A2 APU POWER CONTROL RLY
TERM A1, C1 INLET FLOW SOV RLY
TERM S2 APU POWER CONTROL RLY
TERM S2 APU START RLY
TERM F2 APU INLET DOOR NO. 1 RLY
TERM E2 APU APU POWER CONTROL RLY
TB324-14(A) TERM MODULE
28V DC TO GEN LOP AND OIL OVERTEMP SWITCHES
4999-TB1 FILTER ASSY
FESC
ZONE 113
APU COMP
THERMOSTATIC SWITCH
SOLENOID VALVE
DIODE MODULE
WM DIA CROSS REF.
CODE | WIRING DIA | SH
1 | 49-11-02
2 | 24-62-07
3 | 49-61-02 | 1,2
4 | 49-61-02 | 1
5 | 49-61-02 | 2
6 | 49-31-02
7 | 49-11-03 | 1
8 | 49-61-01 | 1
9 | 49-61-01 | 1,2
NOTE
1 [1-1] - CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
2 [22 10-00, 1] - CROSS REF. TO SCHEM IN DIFFERENT ATA NO.
3 (2, 3) - CROSS REF. TO SHEET NO. IN SAME SCHEM
4 —4— - NO. IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
5 SEE 22 INDEX FOR ABBREVIATIONS
6 ALL REF. DESIGNATIONS ARE PREFIXED WITH 4911 UNLESS OTHERWISE SPECIFIED
7 AIRCRAFT WITHOUT SB 49-038
8 AIRCRAFT WITH SB 49-038
9 AIRCRAFT WITH SB 49-061

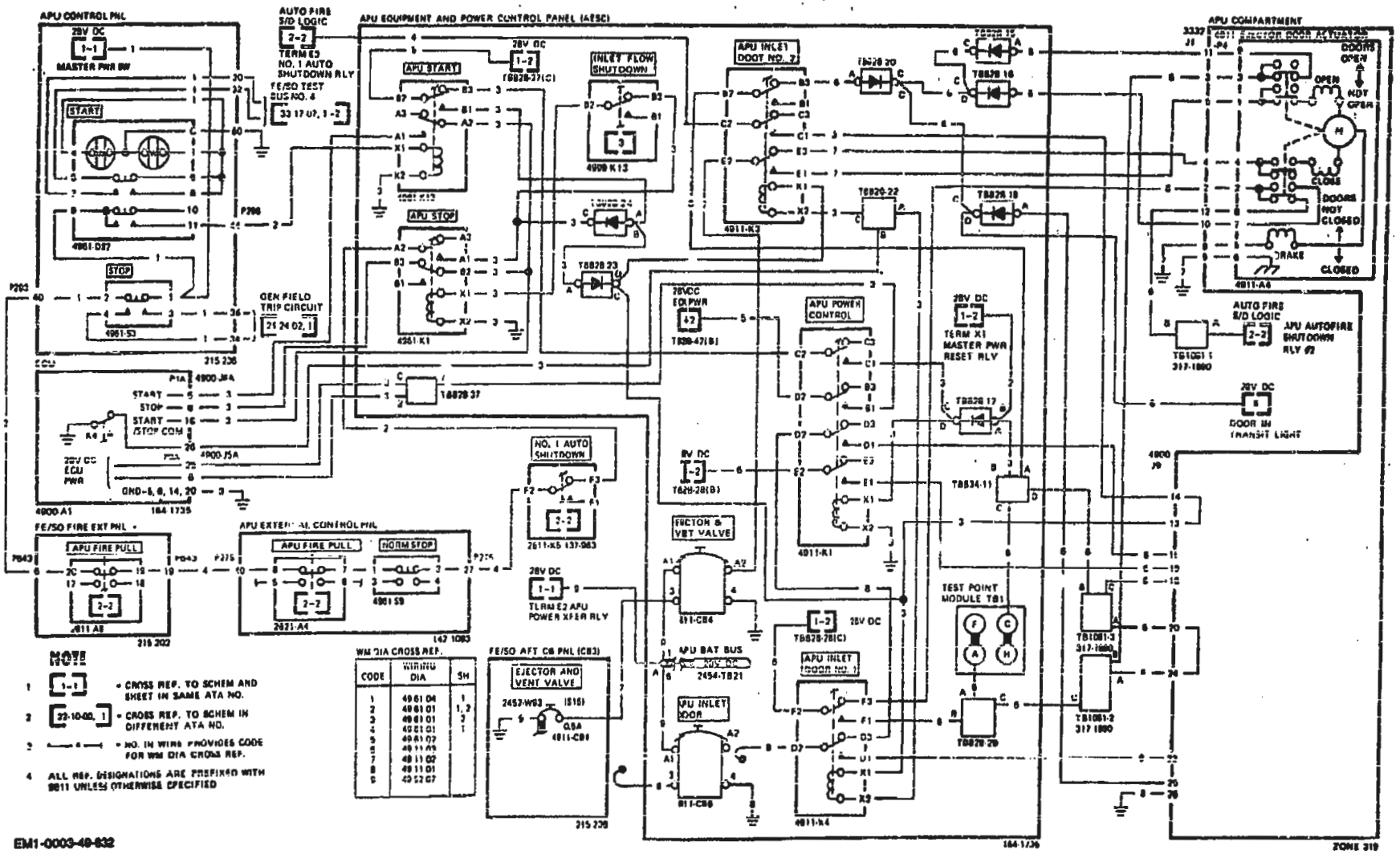
APU Power Distribution Circuits
SCHEM 1 (Sheet 2)

R EFFECTIVITY: 015-023
R
002B


APU EQUIPMENT AND POWER CONTROL PANEL (AEEA)
APU POWER CONTROL
VR APU CONT 6V6
BATTERY POWER CONT
CONTROLLER POWER
4961-CB11
4961-VR1
4961-K2
4961-CB8
4999-T81 FILTER ASSY
T R POWER INTERRUPT RELAY
4961-K15
4911-K3
4911-K7
APU INLET DOOR NO. 2
MASTER POWER RESET
TERM A3 APU POWER XFR RLY
TERM A2 APU PRI F/W SOV RLY
TERM A2 APU POWER CONTROL RELAY
TERM A1, C1 INLET FLOW S/O RELAY
TERM B2 APU POWER CONTROL RELAY
TERM B2 APU START RLY
TERM F2 APU INLET DOOR NO. 1 RLY
TERM E2 APU PWR CONT RLY
TERM A2 APU POWER CONTROL RELAY
28V DC TO GEN LOP AND OIL OVERTEMP SWITCHES
APU CONT PNL P298, PIN 41
TB1210-17 DIODE MODULE
TB1192-49 (A) TERM MODULE
FESC
4900-TE7 113-757
4961-CR16
4961-CR17
4961-CR14
4961-CR15
ZONE 117
FE/CO AFT CB PANEL (CO3)
POWER CONTROL
APU BAT BUS-CONT PWR
CONTROL & PRI F/W SOV-GND BUS
CONTROLS & PRI F/W SOV BUS 2
CONTROLLER -GND BUS
CONTROLLER-BUS 2
DC GND SVCE BUS
DC BUS 2
4961-CB7
4961-CB6
4961-CB5
4961-CB4
2452-W93
WM DIA CROSS REF.
CODE | WIRING DIA | SH
1 | 49-11-02
2 | 24-53-07 | 1
3 | 49-61-02 | 1,2
4 | 49-61-02 | 1
5 | 49-61-02 | 2
6 | 49-31-02 | 2
7 | 49-11-03 | 2
8 | 49-61-01 | 2
9 | 49-61-01 | 1,2
APU COMP
THERMOSTATIC SWITCH
SOLENOID VALVE
AIRCRAFT WITH SB 49-061
NOTE
1 [1-1] • CROSS REF TO SCHEM AND SHEET IN SAME ATA NO
2 [22 10-00 1] • CROSS REF TO SCHEM IN DIFFERENT ATA NO.
3 [2, 3] • CROSS REF. TO SHEET NO IN SAME SCHEM
4 • NO IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
5 SEE 22 INDEX FOR ABBREVIATIONS
6 ALL REF. DESIGNATIONS ARE PREFIXED WITH 4911 UNLESS OTHERWISE SPECIFIED

APU Power Distribution Circuits
SCHEM 1 (Sheet 2)

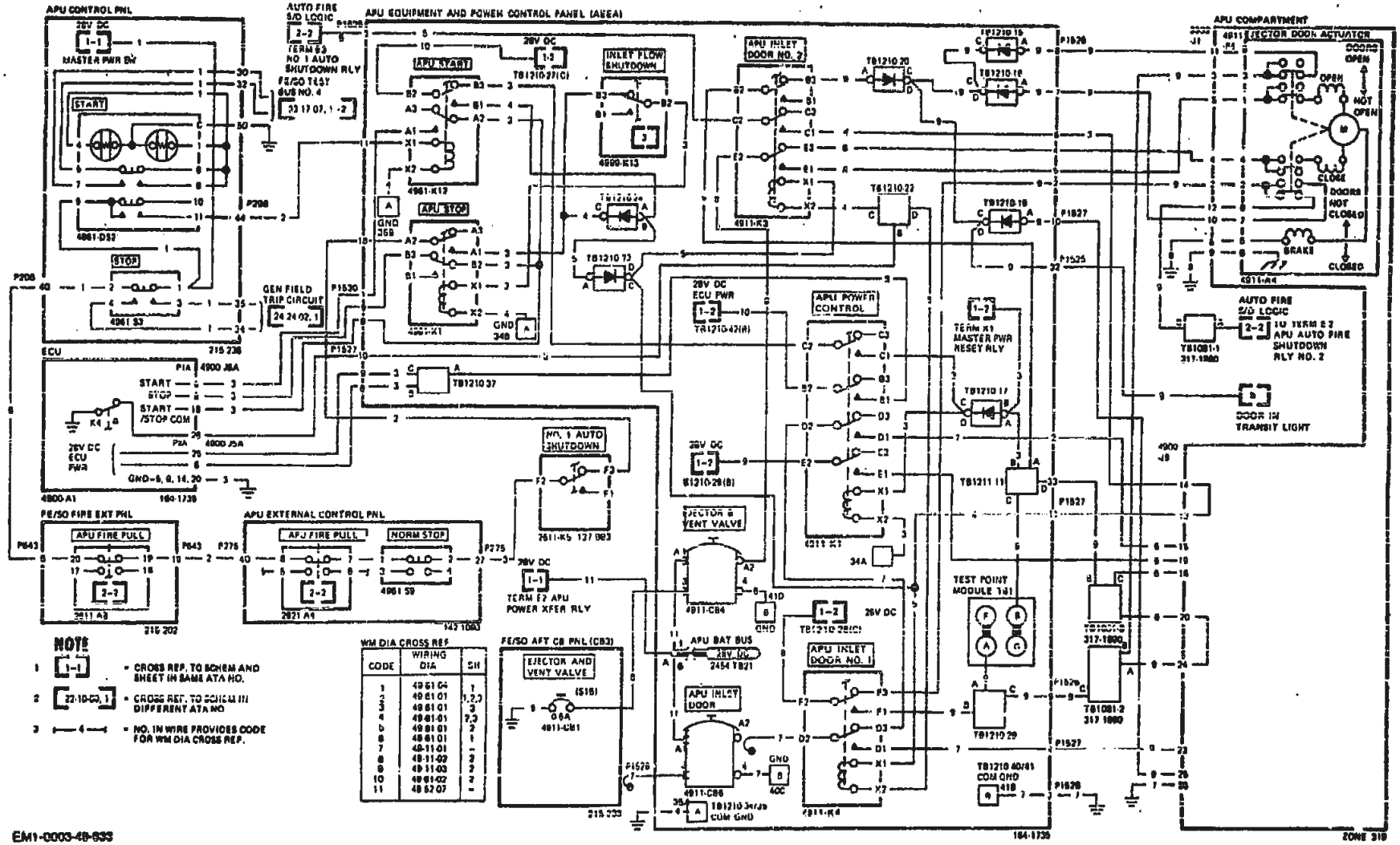
R EFFECTIVITY: 024-036
R
002B



APU Start/Stop Circuit
SCHEM 2 (Sheet 1)

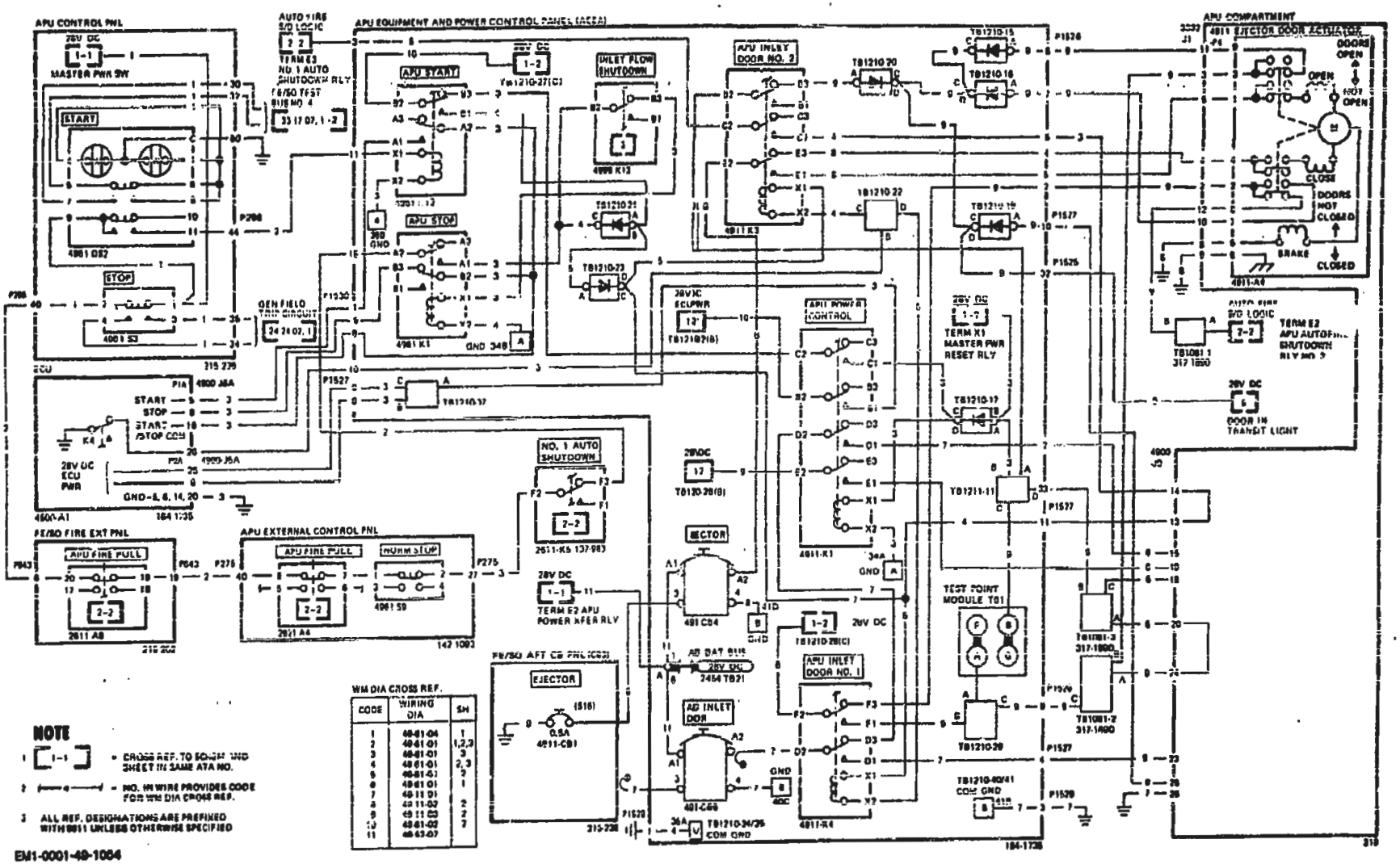
R
R
002B

EFFECTIVITY: 001-023



APU Start/Stop Circuits
SCHEM 2 (Sheet 1)

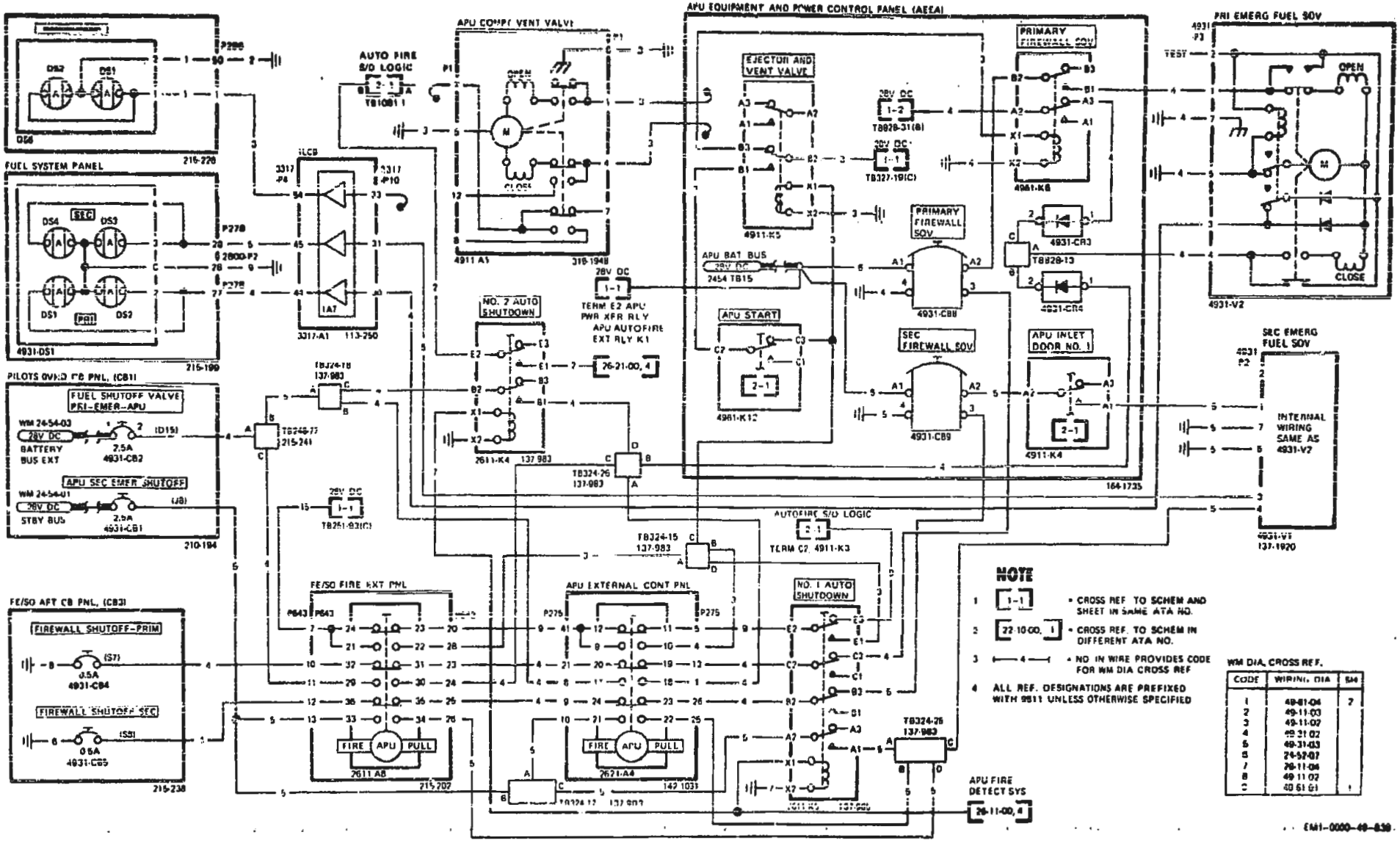
R EFFECTIVITY: 024-031
R
002B



APU Start/Stop Circuits
SCHEM 2 (Sheet 1)

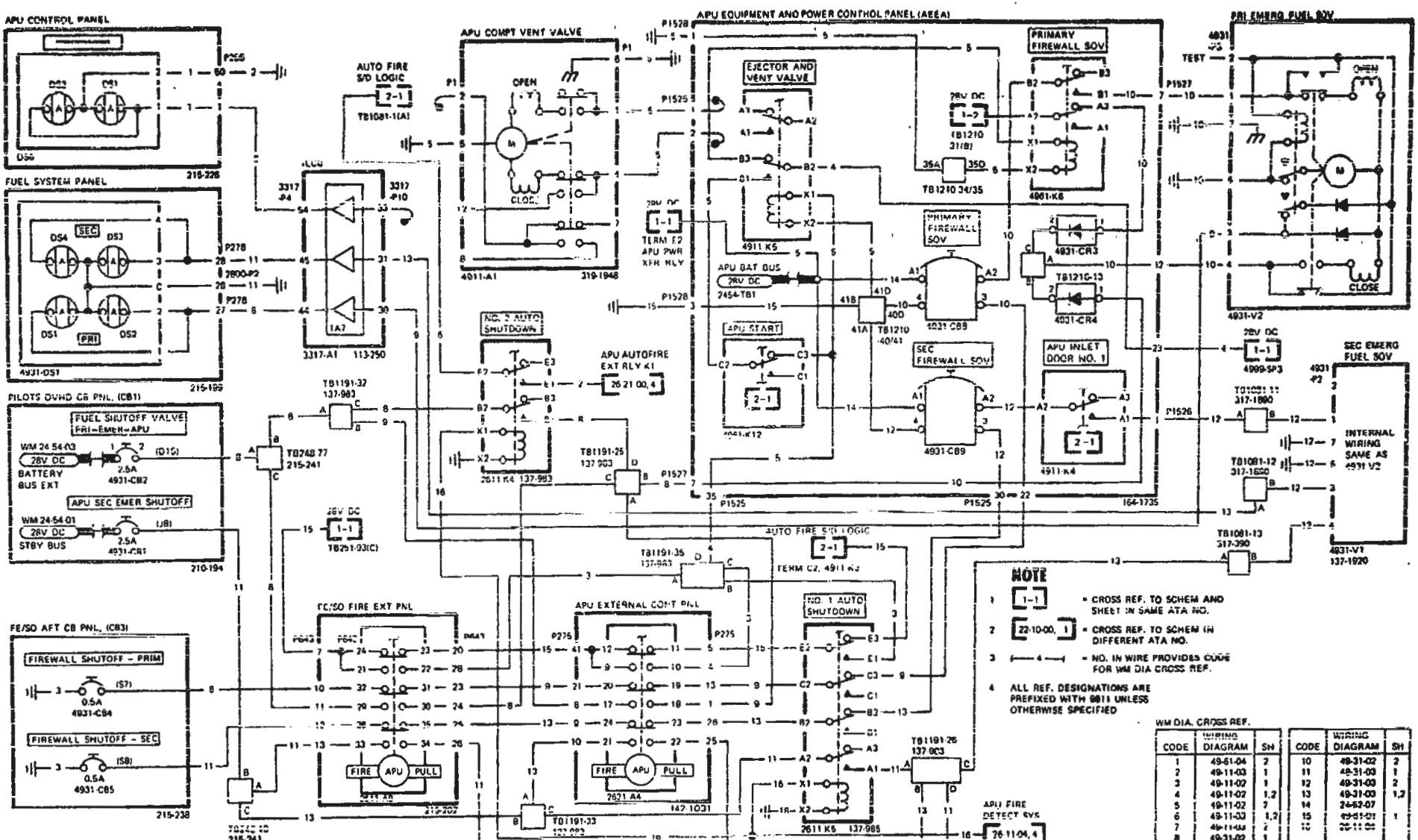
R
R
002B

EFFECTIVITY: 032-036


APU EQUIPMENT AND POWER CONTROL PANEL (AEEA)
APU COMPT VENT VALVE
AUTO FIRE S/D LOGIC
FUEL SYSTEM PANEL
PILOTS OVHD CB PNL, (CB1)
FUEL SHUTOFF VALVE PRI-EMER-APU
APU SEC EMER SHUTOFF
FE/SO AFT CB PNL, (CB3)
FIREWALL SHUTOFF-PRIM
FIREWALL SHUTOFF-SEC
FE/SO FIRE EXT PNL
APU EXTERNAL CONT PNL
EJECTOR AND VENT VALVE
PRIMARY FIREWALL SOV
SEC FIREWALL SOV
APU START
APU BAT BUS
APU INLET DOOR NO. 1
NO. 2 AUTO SHUTDOWN
NO. 1 AUTO SHUTDOWN
AUTOFIRE S/D LOGIC
PRI EMERG FUEL SOV
SEC EMERG FUEL SOV
INTERNAL WIRING SAME AS 4931-V2
APU FIRE DETECT SYS
NOTE
1 CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
2 CROSS REF. TO SCHEM IN DIFFERENT ATA NO.
3 NO IN WIRE PROVIDES CODE FOR WM DIA CROSS REF
4 ALL REF. DESIGNATIONS ARE PREFIXED WITH 9811 UNLESS OTHERWISE SPECIFIED
WM DIA. CROSS REF.
CODE | WIRING DIA | SH
1 | 49-81-04 | 2
2 | 49-11-03
3 | 49-11-07
4 | 49-21-02
5 | 49-31-03
6 | 24-52-07
7 | 26-11-06
8 | 49-11-02
9 | 49-61-01 | 1

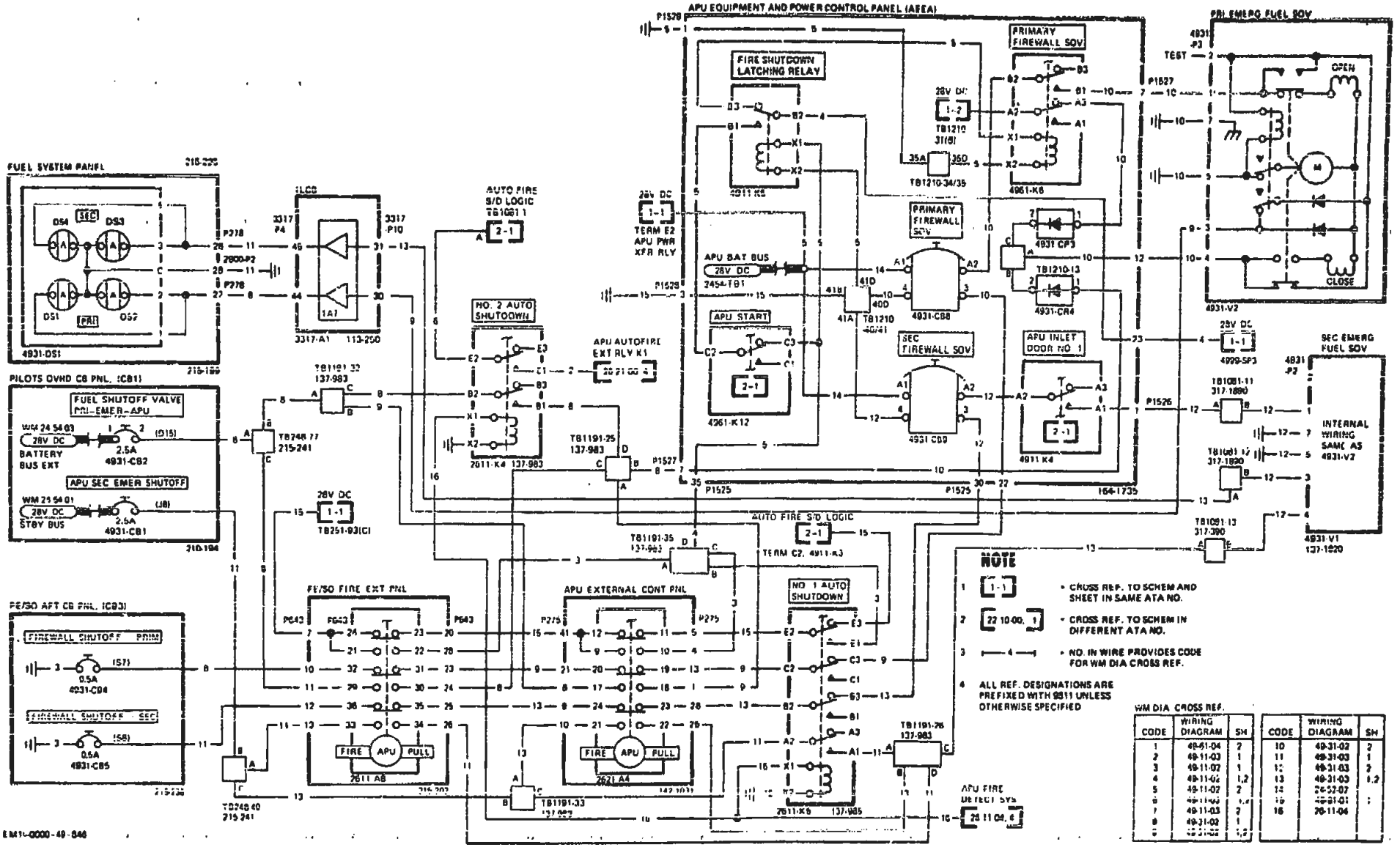
APU Start/Stop Circuit
SCHEM 2 (Sheet 2)

R EFFECTIVITY: 001-023
R
002B


APU CONTROL PANEL
FUEL SYSTEM PANEL
PILOTS OVHD CB PNL. (CB1)
FE/SO AFT CB PNL. (CB3)
APU COMPT VENT VALVE
AUTO FIRE S/D LOGIC
APU EQUIPMENT AND POWER CONTROL PANEL (AEEA)
EJECTOR AND VENT VALVE
PRIMARY FIREWALL SOV
PRI EMERG FUEL SOV
APU BAT BUS
APU START
SEC FIREWALL SOV
APU INLET DOOR NO. 1
SEC EMERG FUEL SOV
NO. 2 AUTO SHUTDOWN
APU AUTOFIRE EXT RLY K1
FUEL SHUTOFF VALVE PRI-EMER-APU
APU SEC EMER SHUTOFF
FE/SO FIRE EXT PNL
APU EXTERNAL CONT PNL
NO. 1 AUTO SHUTDOWN
FIREWALL SHUTOFF - PRIM
FIREWALL SHUTOFF - SEC
APU FIRE DETECT SYS
INTERNAL WIRING SAME AS 4931 V2
NOTE
1 [1-1] = CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
2 [22-10-00, 1] = CROSS REF. TO SCHEM IN DIFFERENT ATA NO.
3 —4— = NO. IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
4 ALL REF. DESIGNATIONS ARE PREFIXED WITH 0811 UNLESS OTHERWISE SPECIFIED
WM DIA. CROSS REF.
CODE | WIRING DIAGRAM | SH
1 | 49-61-04 | 2
2 | 49-11-03 | 1
3 | 49-11-02 | 1
4 | 49-11-02 | 1,2
5 | 49-11-02 | 2
6 | 49-11-03 | 1,2
7 | 49-11-03 | 2
8 | 49-31-02 | 1
9 | 49-31-02 | 1,2
10 | 49-31-02 | 2
11 | 49-31-03 | 1
12 | 49-31-03 | 2
13 | 49-31-03 | 1,2
14 | 24-62-07 | 1
15 | 49-61-01 | 1
16 | 49-11-04 | 2

APU Start/Stop Circuits
SCHEM 2 (Sheet 2)

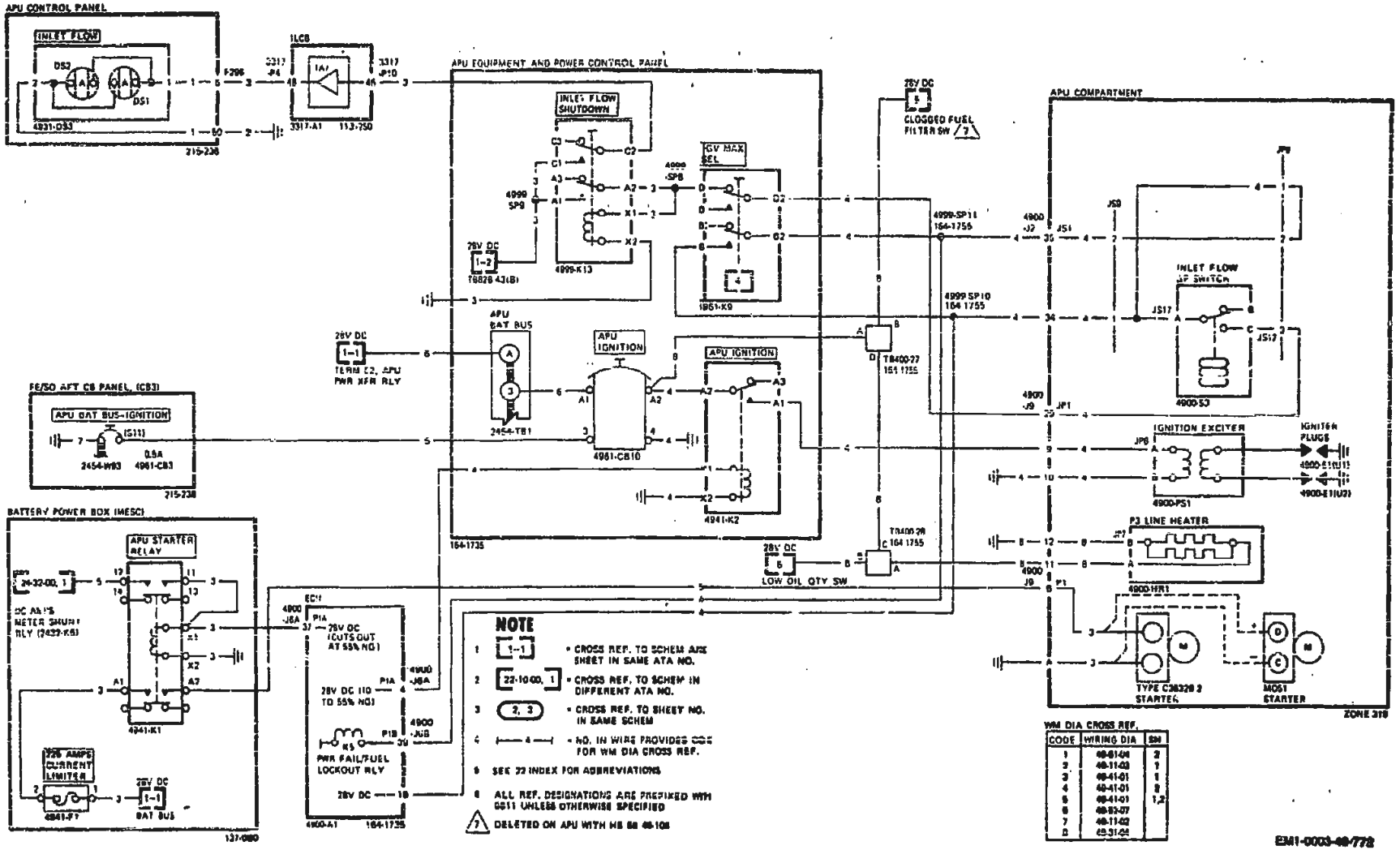
R EFFECTIVITY: 024-031
R
002B



EM1-0000-49-846

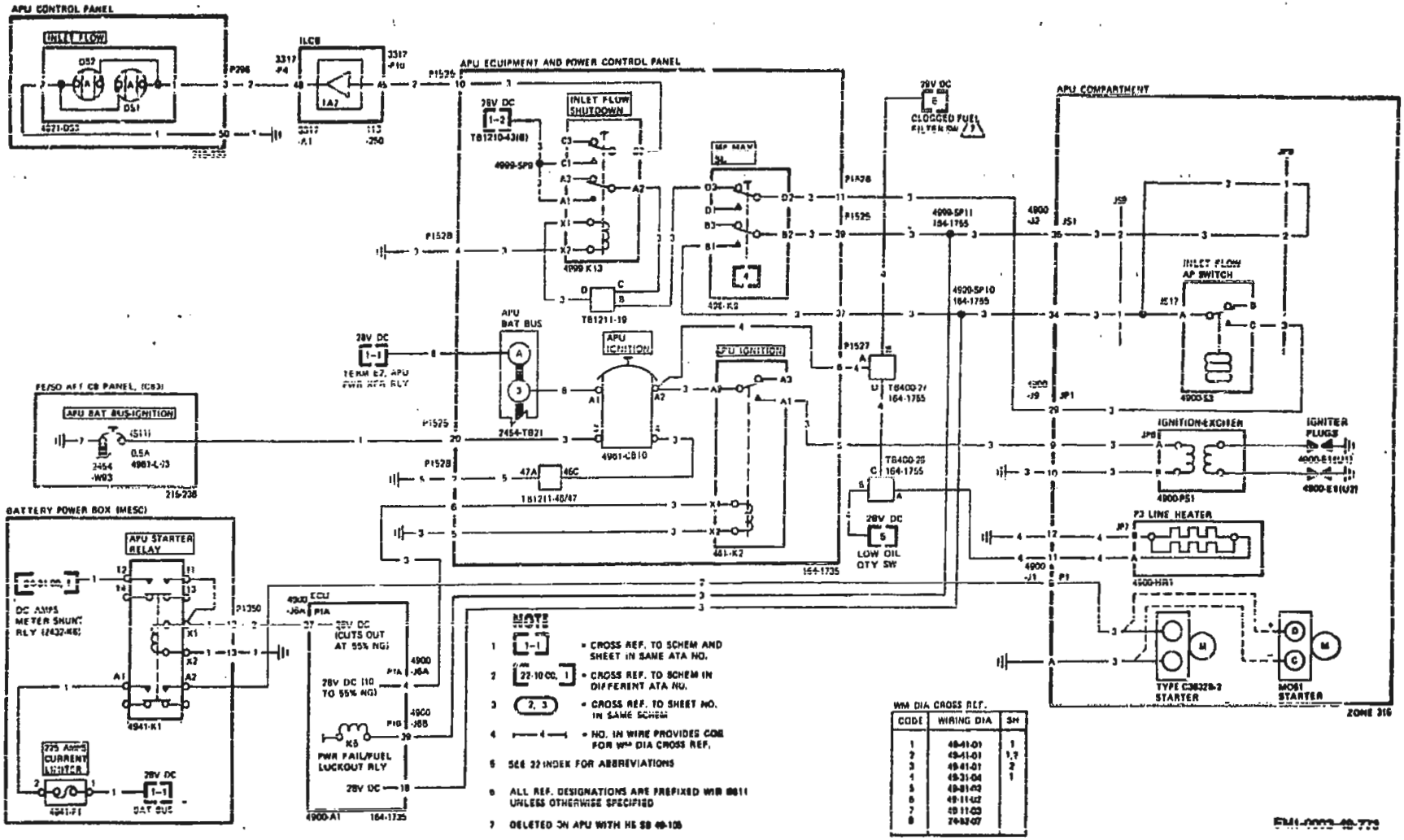
APU Start/Stop Circuit
SCHEM 2 (Sheet 2)

R EFFECTIVITY: 032-036
R
002B



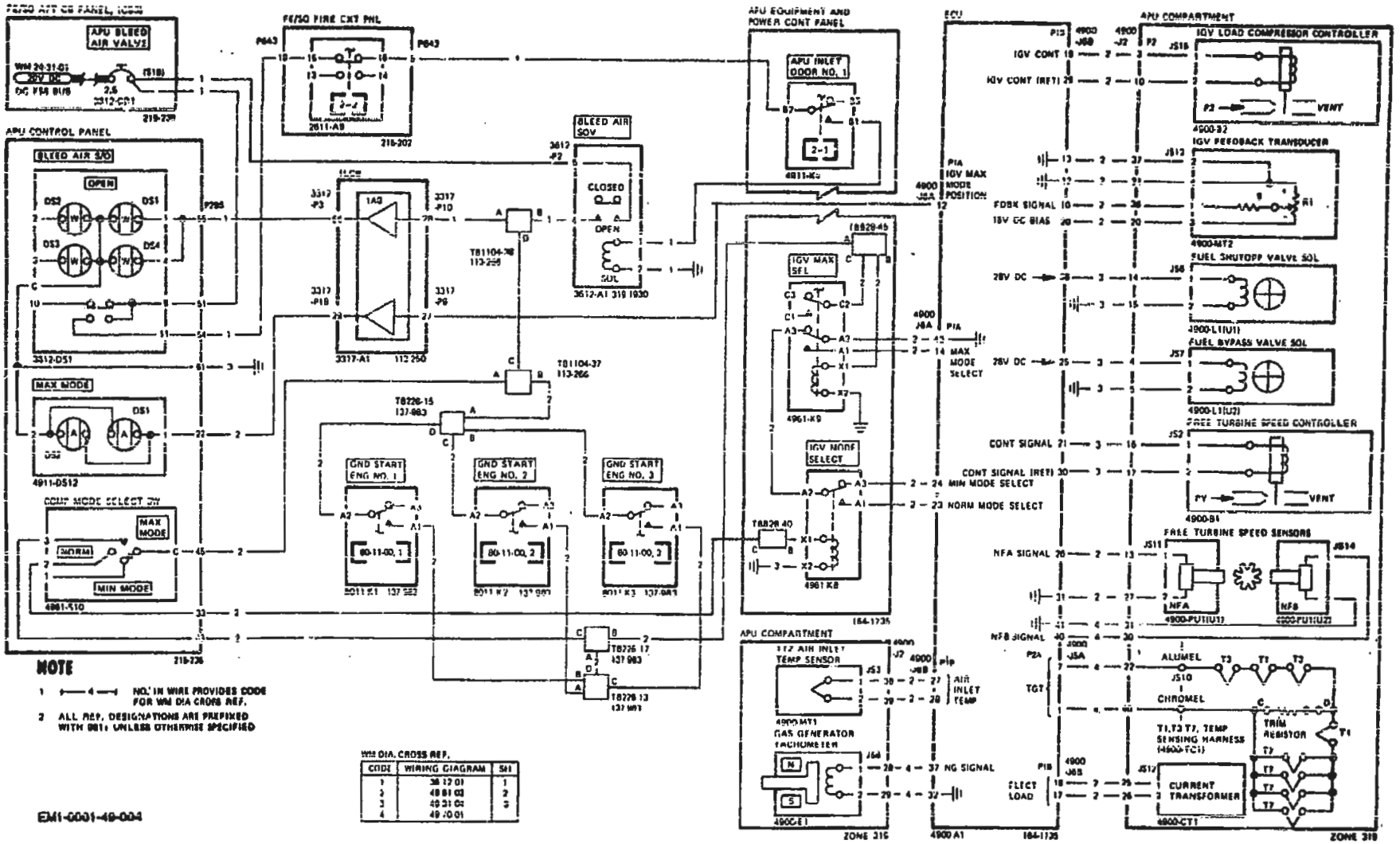
C APU Starter and Ignition Circuits
C SCHEM 3

R EFFECTIVITY: 001-023
R
002B



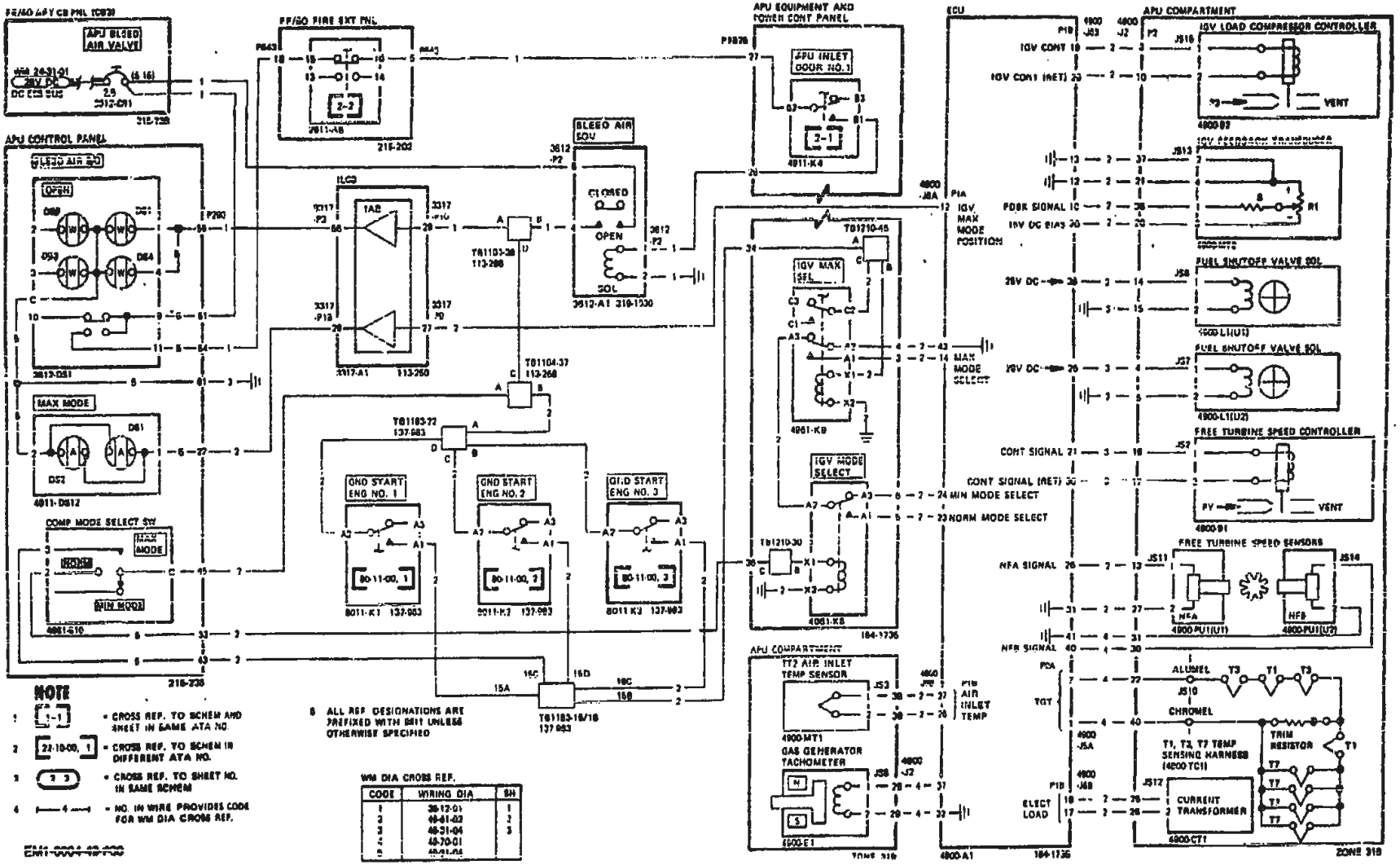
APU Starter and Ignition Circuits
SCHEM 3

EFFECTIVITY: 024-036

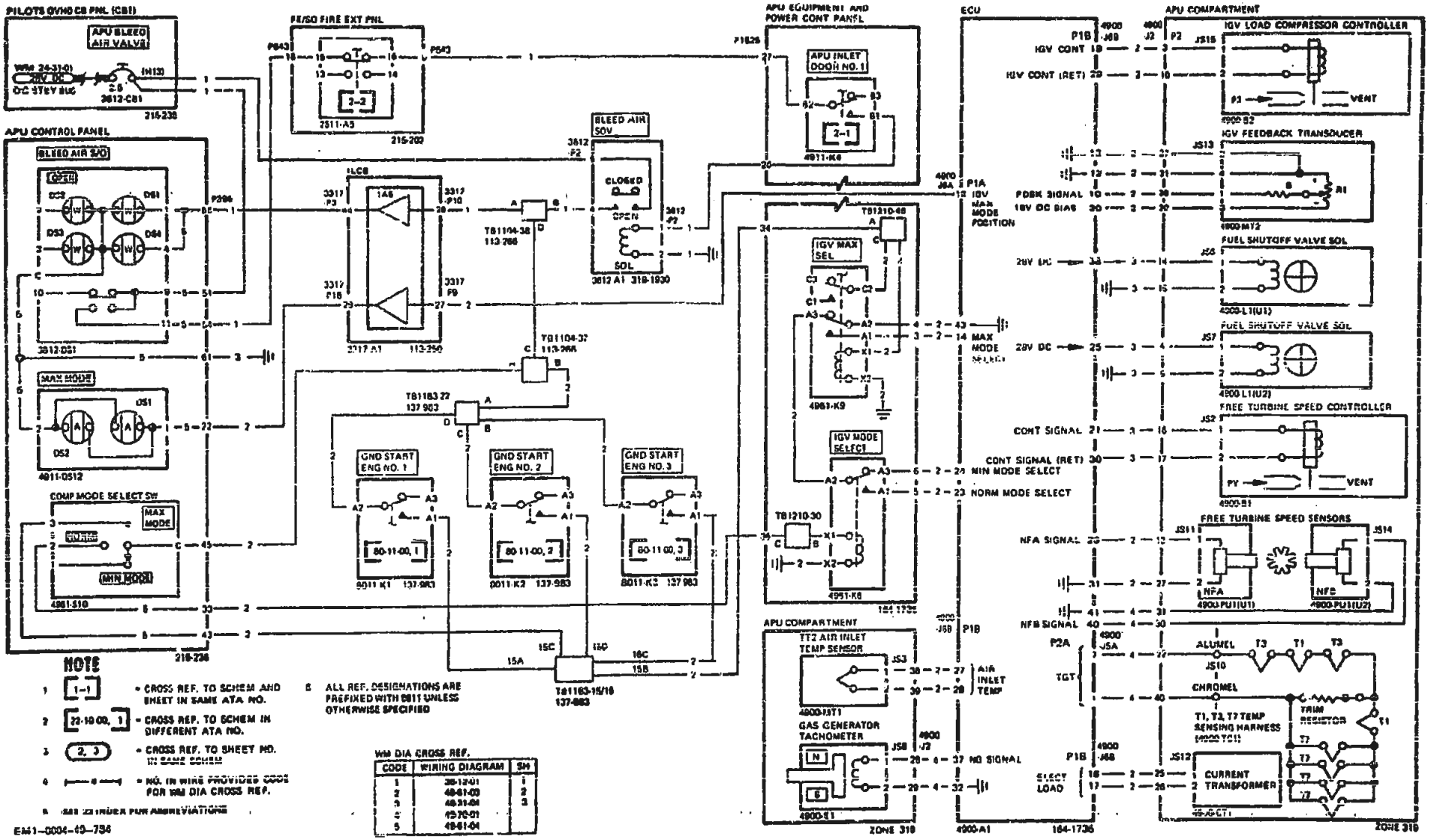


APU Engine and Load Compressor Control Circuits
SCHEM 4

R EFFECTIVITY: 001-023
R
G028

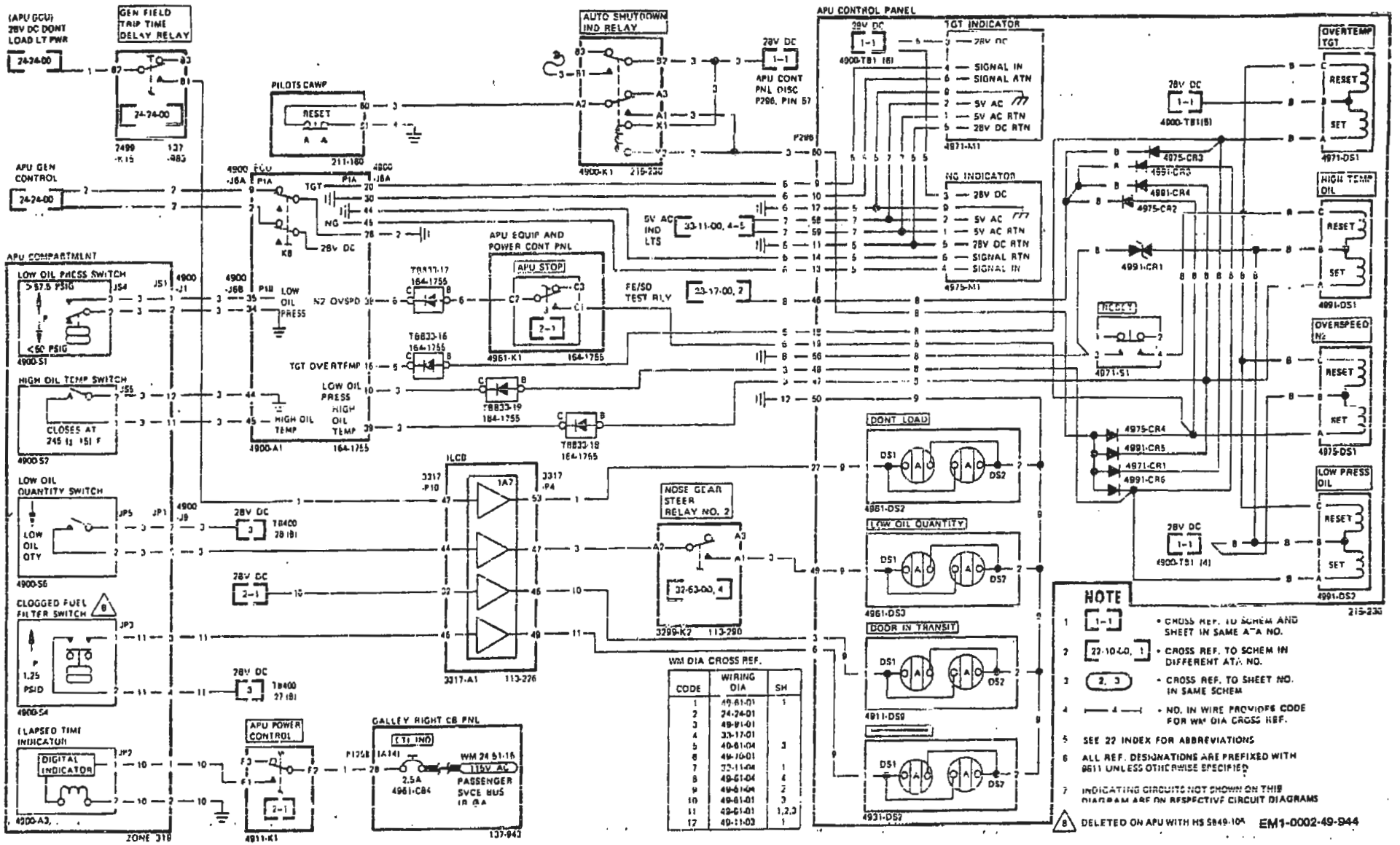


APU Engine and Load Compressor Control Circuits
SCHEM 4



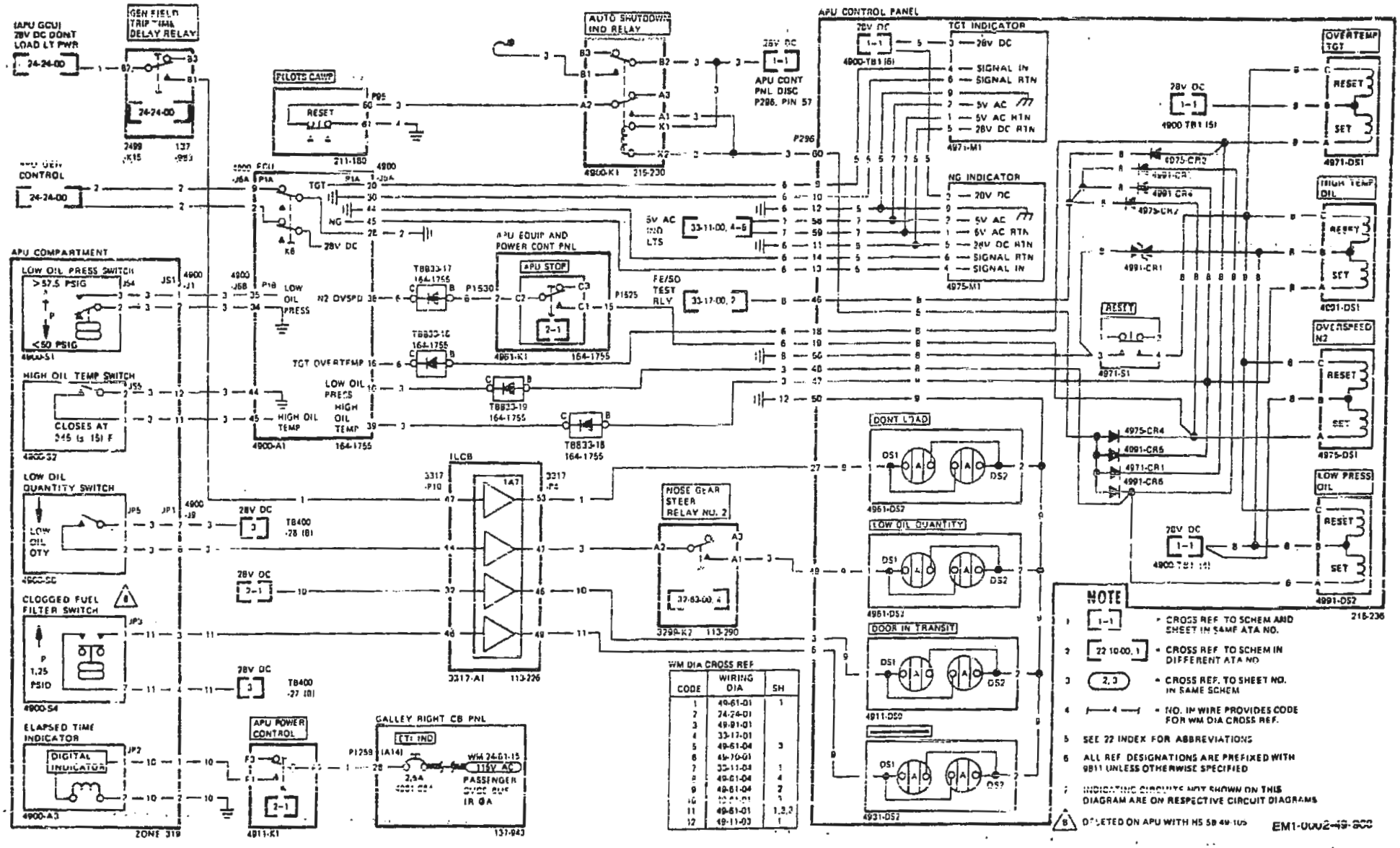
APU Engine and Load Compressor Control Circuits
SCHEM 4

R EFFECTIVITY: 032-999
R
002B



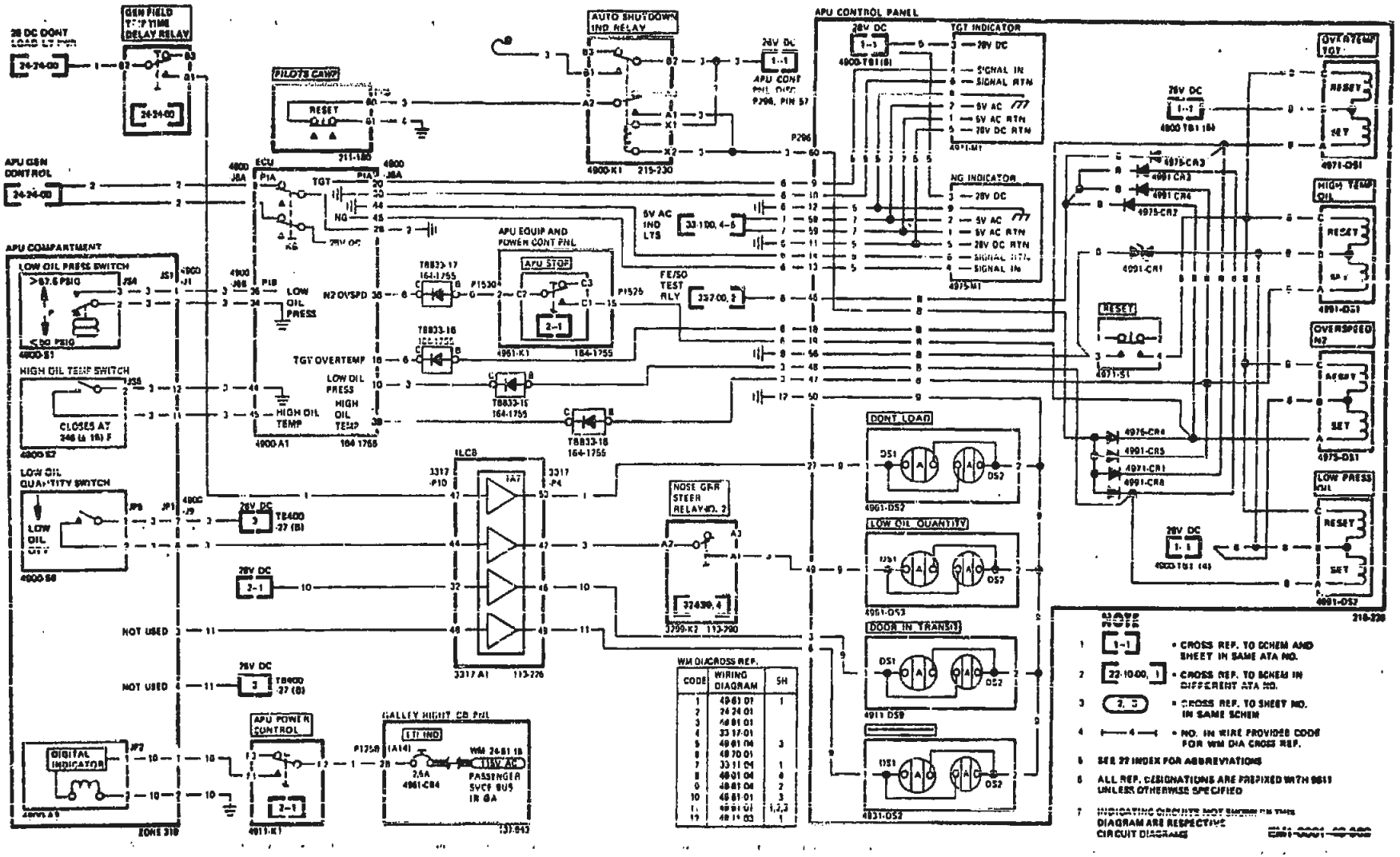
APU Indicating Circuits
SCHEM 5

R EFFECTIVITY: 001-023
R
002B



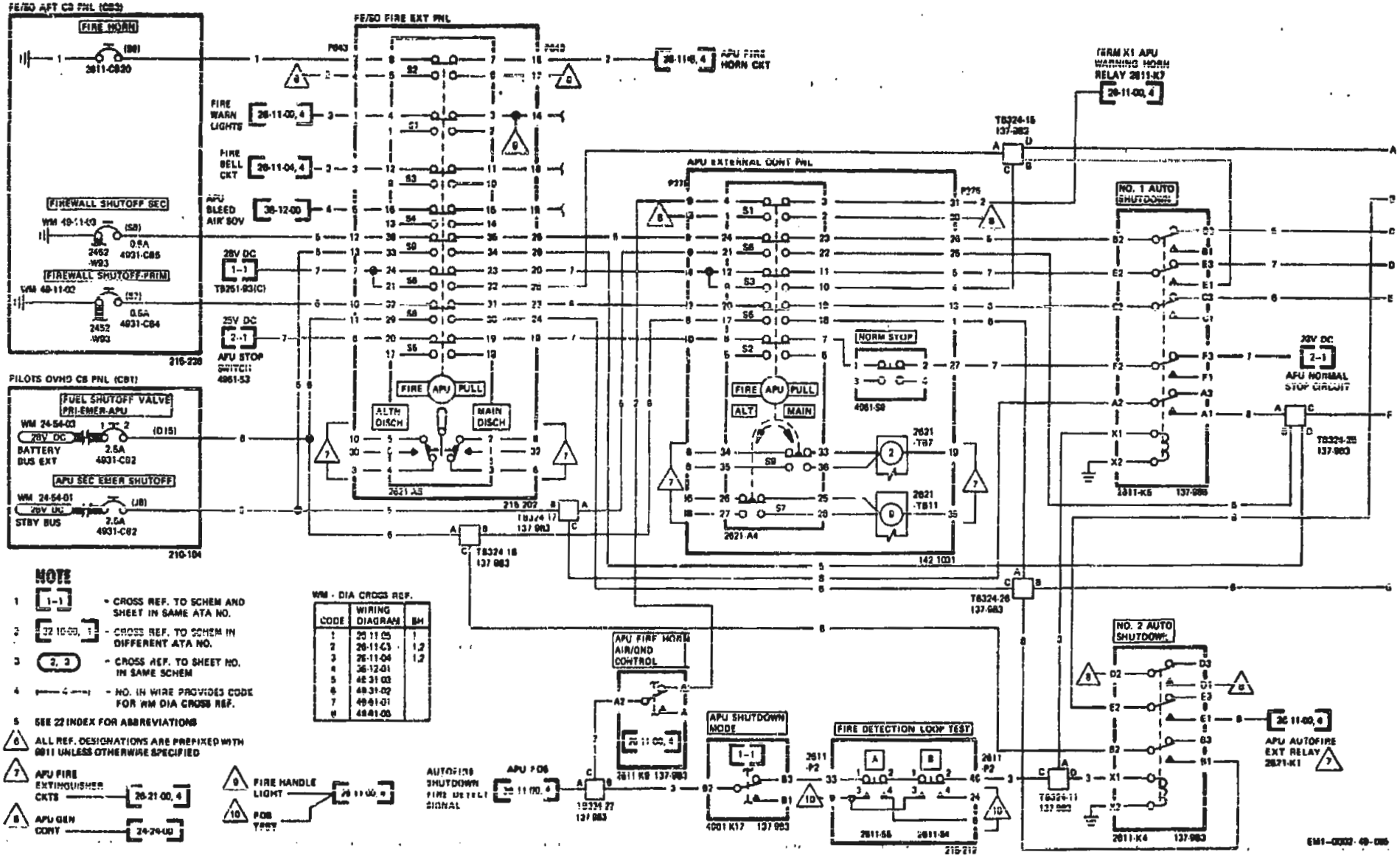
APU Indicating Circuits
SCHEM 5

R EFFECTIVITY: 024-031
R
002B



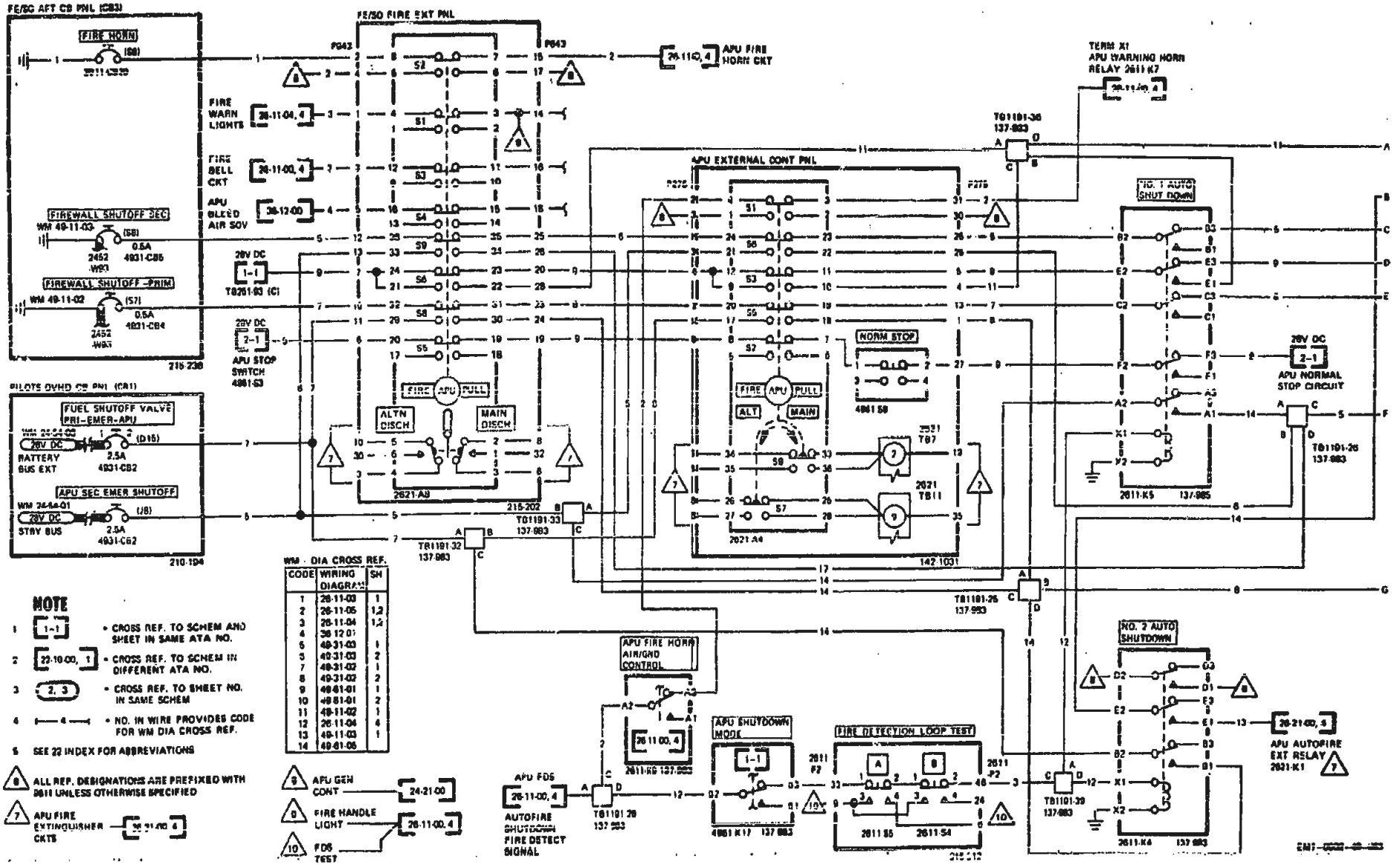
APU Indicating Circuits
SCHEM 5

EFFECTIVITY: 032-036



APU Manual/Autofire Shutdown Circuits
SCHEM 6 (Sheet 1)

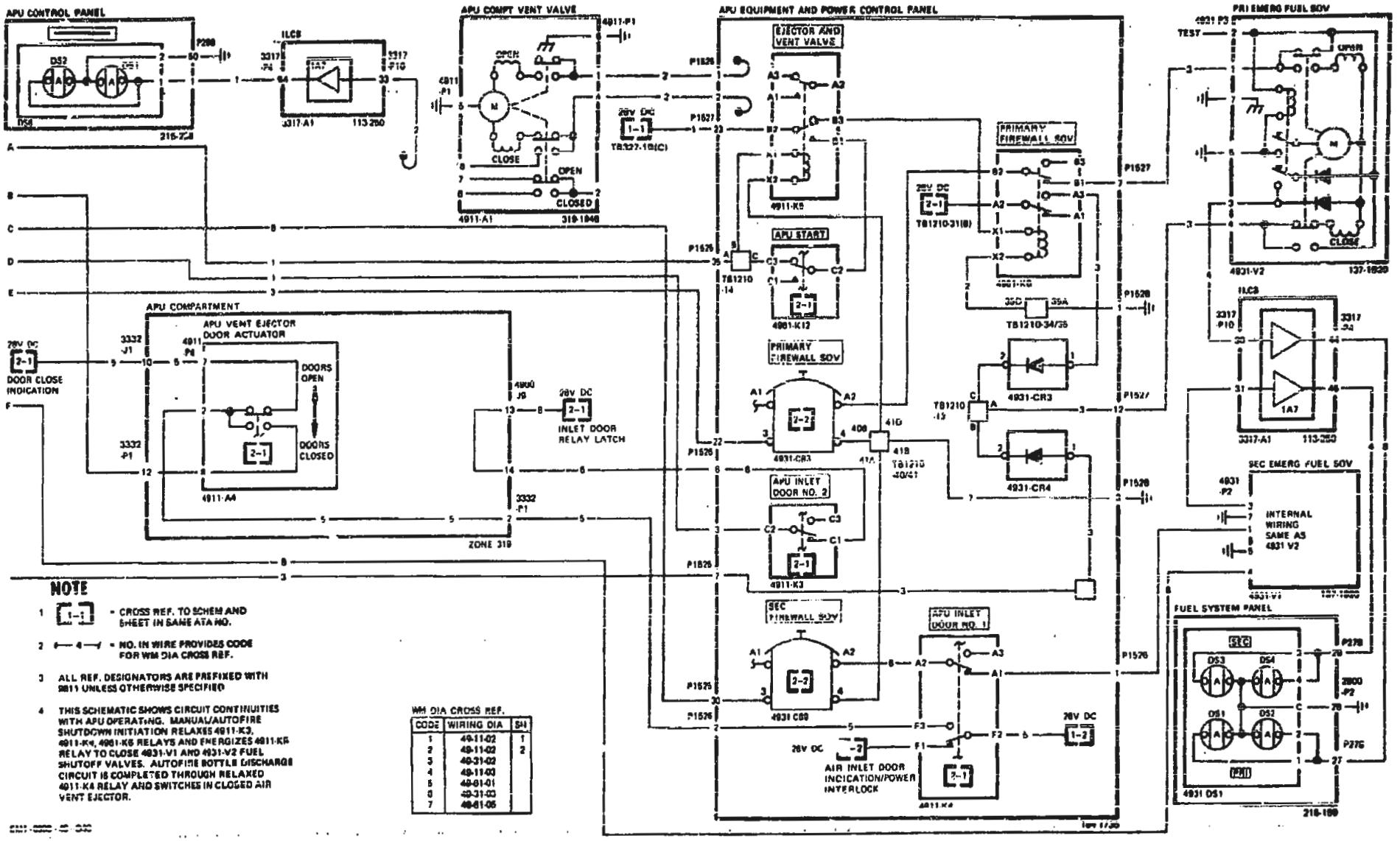
R EFFECTIVITY: 001-023
R
002B


FE/SC AFT CB PNL (CB3)
FIRE HORN
FIREWALL SHUTOFF SEC
FIREWALL SHUTOFF -PRIM
PILOTS OVHD CB PNL (CA1)
FUEL SHUTOFF VALVE PRI-EMER-APU
APU SEC EMER SHUTOFF
FE/SO FIRE EXT PNL
FIRE WARN LIGHTS
FIRE BELL CKT
APU BLEED AIR SOV
APU STOP SWITCH 4961-S3
FIRE APU PULL
ALTN DISCH
MAIN DISCH
APU FIRE HORN CKT
APU EXTERNAL CONT PNL
NORM STOP
ALT
MAIN
TERM X1 APU WARNING HORN RELAY 2611-K7
APU NORMAL STOP CIRCUIT
NO. 1 AUTO SHUT DOWN
NO. 2 AUTO SHUTDOWN
APU FIRE HORN AIR/GND CONTROL
APU SHUTDOWN MODE
FIRE DETECTION LOOP TEST
APU AUTOFIRE EXT RELAY 2631-K1
AUTOFIRE SHUTDOWN FIRE DETECT SIGNAL
APU GEN CONT
FIRE HANDLE LIGHT
FDS TEST
WM - DIA CROSS REF.
CODE
WIRING DIAGRAM
SH
NOTE
• CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
• CROSS REF. TO SCHEM IN DIFFERENT ATA NO.
• CROSS REF. TO SHEET NO. IN SAME SCHEM
• NO. IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
SEE 22 INDEX FOR ABBREVIATIONS
ALL REF. DESIGNATIONS ARE PREFIXED WITH 2611 UNLESS OTHERWISE SPECIFIED
APU FIRE EXTINGUISHER CKTS

APU Manual/Autofire Shutdown Circuits
SCHEM 6 (Sheet 1)

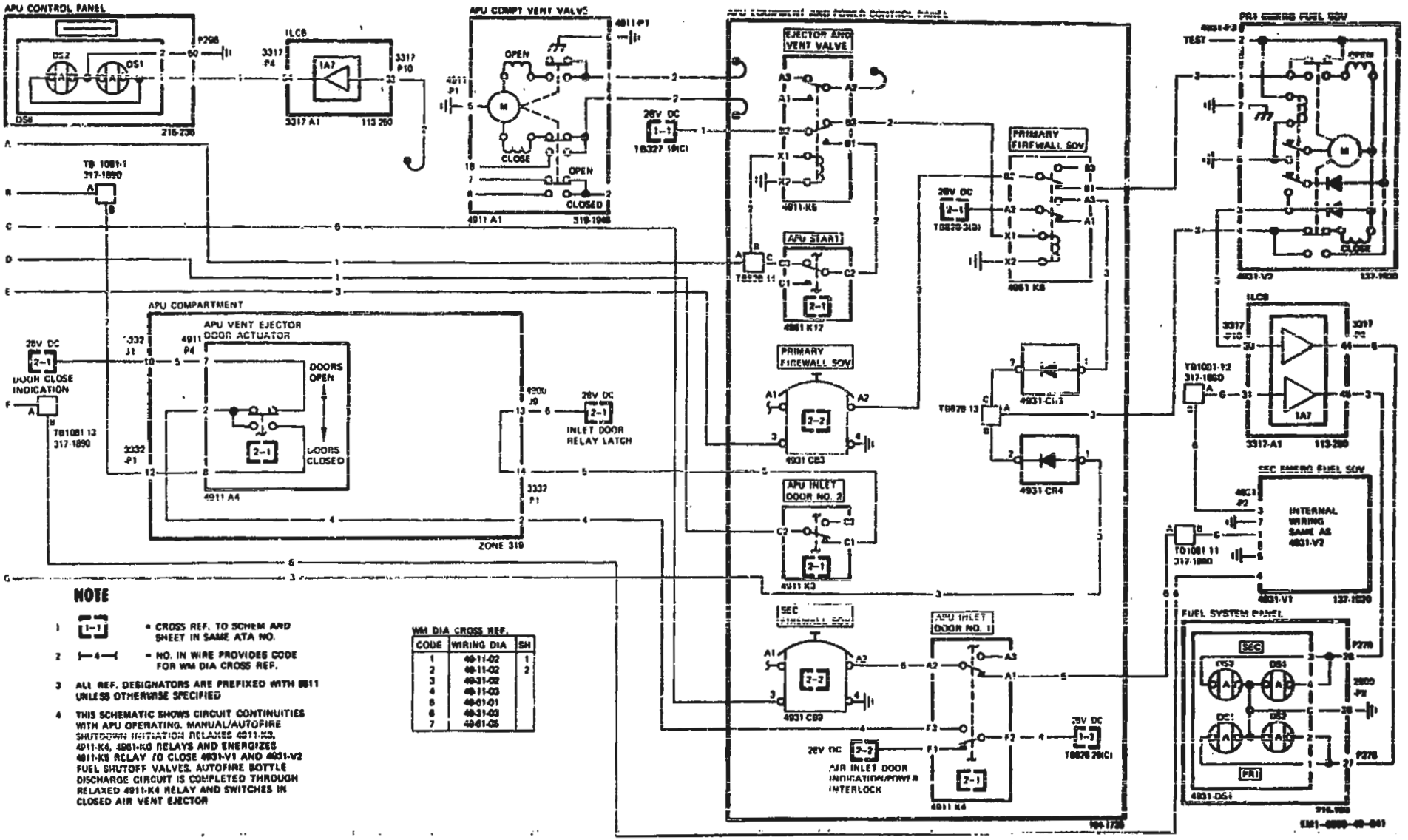
R
R
0026

EFFECTIVITY: 024-036


APU CONTROL PANEL
APU COMPT VENT VALVE
APU EQUIPMENT AND POWER CONTROL PANEL
PRI EMERG FUEL SOV
EJECTOR AND VENT VALVE
PRIMARY FIREWALL SOV
APU START
APU COMPARTMENT
APU VENT EJECTOR DOOR ACTUATOR
DOORS OPEN
DOORS CLOSED
28V DC DOOR CLOSE INDICATION
INLET DOOR RELAY LATCH
APU INLET DOOR NO. 2
SEC FIREWALL SOV
APU INLET DOOR NO. 1
AIR INLET DOOR INDICATION/POWER INTERLOCK
SEC EMERG FUEL SOV
INTERNAL WIRING SAME AS 4931 V2
FUEL SYSTEM PANEL
ZONE 319
NOTE
1 [1-1] = CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
2 ←4→ = NO. IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
3 ALL REF. DESIGNATORS ARE PREFIXED WITH 4911 UNLESS OTHERWISE SPECIFIED
4 THIS SCHEMATIC SHOWS CIRCUIT CONTINUITIES WITH APU OPERATING. MANUAL/AUTOFIRE SHUTDOWN INITIATION RELAXES 4911-K3, 4911-K4, 4961-K6 RELAYS AND ENERGIZES 4911-K5 RELAY TO CLOSE 4931-V1 AND 4931-V2 FUEL SHUTOFF VALVES. AUTOFIRE BOTTLE DISCHARGE CIRCUIT IS COMPLETED THROUGH RELAXED 4911-K4 RELAY AND SWITCHES IN CLOSED AIR VENT EJECTOR.
WM DIA CROSS REF.
CODE | WIRING DIA | SH
1 | 49-11-02 | 1
2 | 49-11-02 | 2
3 | 49-31-02
4 | 49-11-03
5 | 49-61-01
6 | 49-31-03
7 | 49-61-05

APU Manual/Autofire Shutdown Circuits
SCHEM 6 (Sheet 2)

R EFFECTIVITY: 001-019
R
002B



NOTE

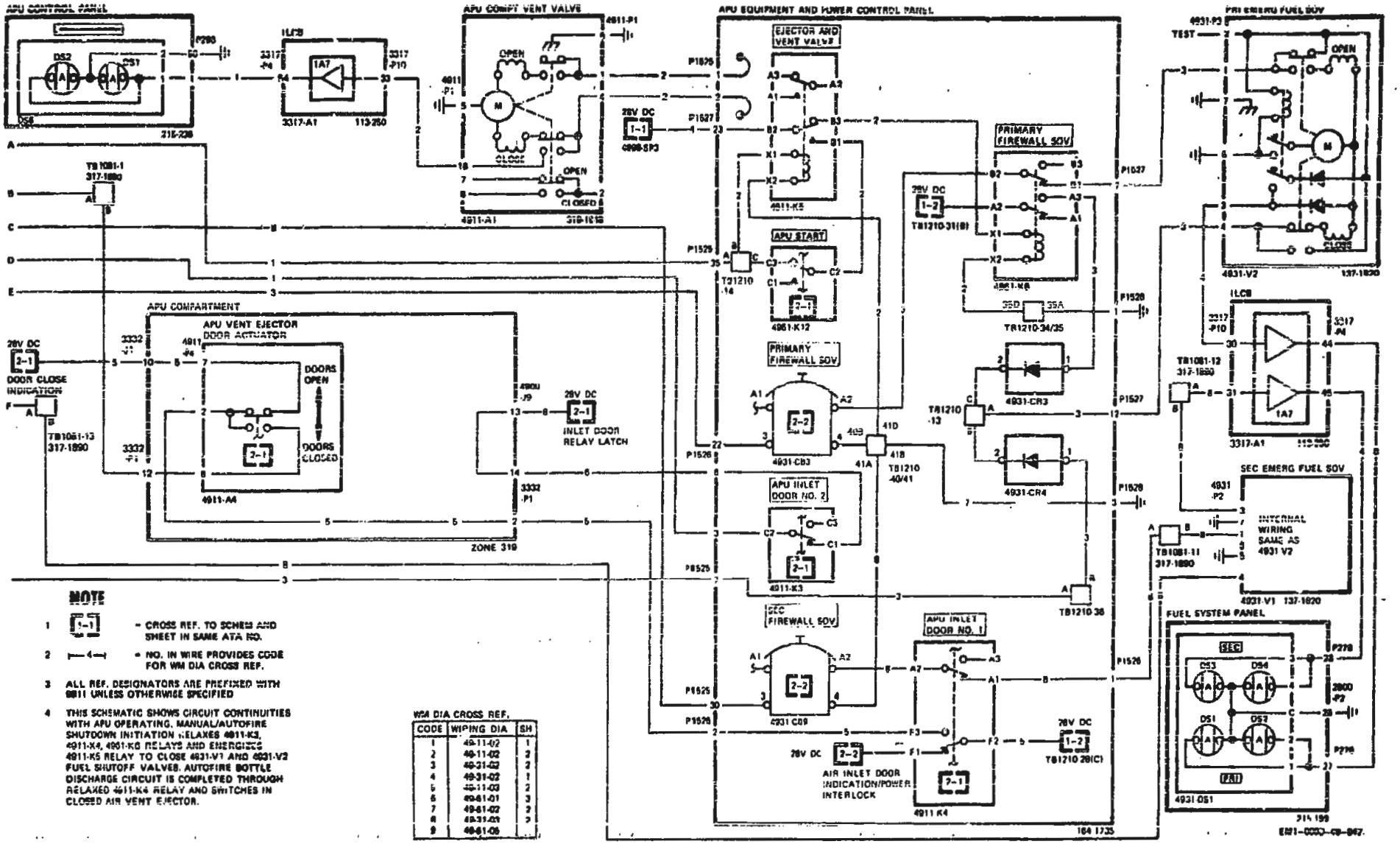
1. [1-1] = CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.
2. 1—4—1 = NO. IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.
3. ALL REF. DESIGNATORS ARE PREFIXED WITH 4911 UNLESS OTHERWISE SPECIFIED
4. THIS SCHEMATIC SHOWS CIRCUIT CONTINUITIES WITH APU OPERATING. MANUAL/AUTOFIRE SHUTDOWN INITIATION RELAXES 4911-K3, 4911-K4, 4961-K6 RELAYS AND ENERGIZES 4911-K5 RELAY TO CLOSE 4931-V1 AND 4931-V2 FUEL SHUTOFF VALVES. AUTOFIRE BOTTLE DISCHARGE CIRCUIT IS COMPLETED THROUGH RELAXED 4911-K4 RELAY AND SWITCHES IN CLOSED AIR VENT EJECTOR

WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	49-11-02	1
2	49-11-02	2
3	49-31-02	
4	49-11-03	
5	49-61-01	
6	49-31-03	
7	49-61-05	

APU Manual/Autofire Shutdown Circuits
SCHEM 6 (Sheet 2)

R EFFECTIVITY: 020-023
R
002R



NOTE

1 [1-1] = CROSS REF. TO SCHEM AND SHEET IN SAME ATA NO.

2 —4— = NO. IN WIRE PROVIDES CODE FOR WM DIA CROSS REF.

3 ALL REF. DESIGNATORS ARE PREFIXED WITH 4911 UNLESS OTHERWISE SPECIFIED

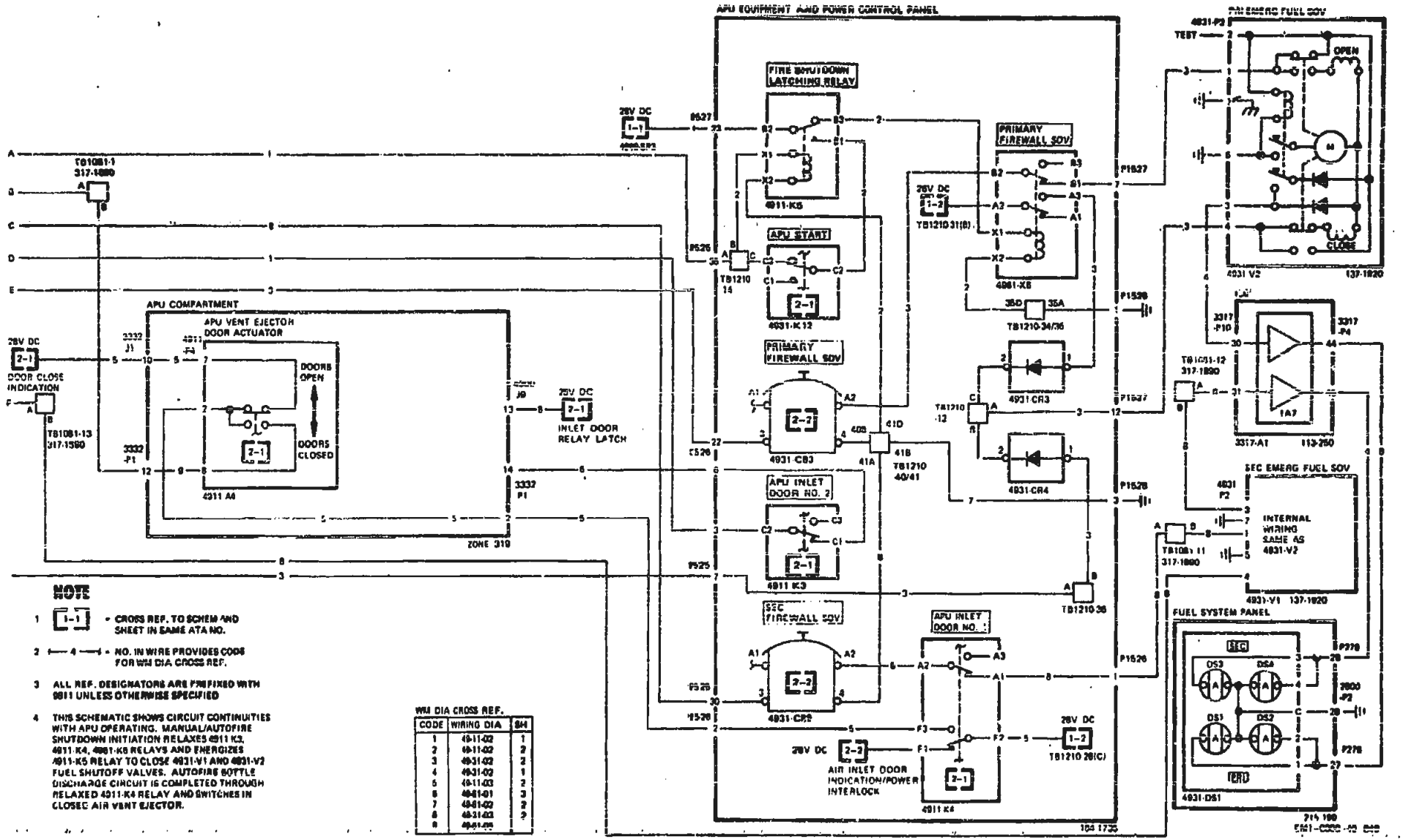
4 THIS SCHEMATIC SHOWS CIRCUIT CONTINUITIES WITH APU OPERATING. MANUAL/AUTOFIRE SHUTDOWN INITIATION RELAXES 4911-K3, 4911-K4, 4961-K6 RELAYS AND ENERGIZES 4911-K5 RELAY TO CLOSE 4931-V1 AND 4931-V2 FUEL SHUTOFF VALVES. AUTOFIRE BOTTLE DISCHARGE CIRCUIT IS COMPLETED THROUGH RELAXED 4911-K4 RELAY AND SWITCHES IN CLOSED AIR VENT EJECTOR.

WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	49-11-02	1
2	49-11-02	2
3	49-31-02	2
4	49-31-02	1
5	49-11-03	2
6	49-61-01	3
7	49-61-02	3
8	49-31-01	3
9	49-61-06	3

APU Manual/Autofire Shutdown Circuits
SCHEM 6 (Sheet 2)

R EFFECTIVITY: 024-031
R
0028


APU EQUIPMENT AND POWER CONTROL PANEL
FIRE SHUTDOWN LATCHING RELAY
4911-K5
APU START
4931-K12
PRIMARY FIREWALL SOV
4931-CR3
4931-CR4
4931-CB3
APU INLET DOOR NO. 2
4911 K3
SEC FIREWALL SOV
4931-CR2
APU INLET DOOR NO. 1
4911 K4
AIR INLET DOOR INDICATION/POWER INTERLOCK
4961-K6
TB1210-34/36
TB1210-40/41
TB1210-38
TB1210-31(B)
TB1210-26(C)
TB1210-14
TB1210-13
TB1210-12
PRI EMERG FUEL SOV
4931-V2
SEC EMERG FUEL SOV
4931-V1
INTERNAL WIRING SAME AS 4931-V2
FUEL SYSTEM PANEL
4931-DS1
APU COMPARTMENT
APU VENT EJECTOR DOOR ACTUATOR
4911 A4
DOORS OPEN
DOORS CLOSED
ZONE 319
DOOR CLOSE INDICATION
INLET DOOR RELAY LATCH
28V DC
TB1081-1
317-1880
TB1081-13
317-1580
TB1081-12
317-1890
TB1081-11
317-1880
3317-A1
113-250
137-1920
P1526
P1527
P1528
P1529
P1530
P1531
P1532
P1533
P1534
P1535
P1536
P1537
P1538
P1539
P1540
P1541
P1542
P1543
P1544
P1545
P1546
P1547
P1548
P1549
P1550
P1551
P1552
P1553
P1554
P1555
P1556
P1557
P1558
P1559
P1560
P1561
P1562
P1563
P1564
P1565

R **APU FORWARD VIBRATION MOUNT - REMOVAL AND INSTALLATION**

R 1. Equipment and Materials

R Lifting sling - APU

R Antiseize Thread Compound, ESSO NO. 1, or equivalent

R Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

R 2. Referenced Procedure

R 49-00-01 Auxiliary Power Unit (APU) Assembly - Removal and
R Installation

R 3. Removal/Installation

R A. Removal

R (1) Remove APU (Ref. 49-00-01).

R (2) Attach lifting sling to forward and aft hoist brackets
R on APU and transfer weight of engine to sling.

R (3) Remove bolts and flat washers attaching vibration mount
R to platform (Ref. Fig. 401).

R (4) Remove bolts and washers attaching vibration mount to
R engine mount pad.

R (5) Remove vibration mount.

R B. Installation

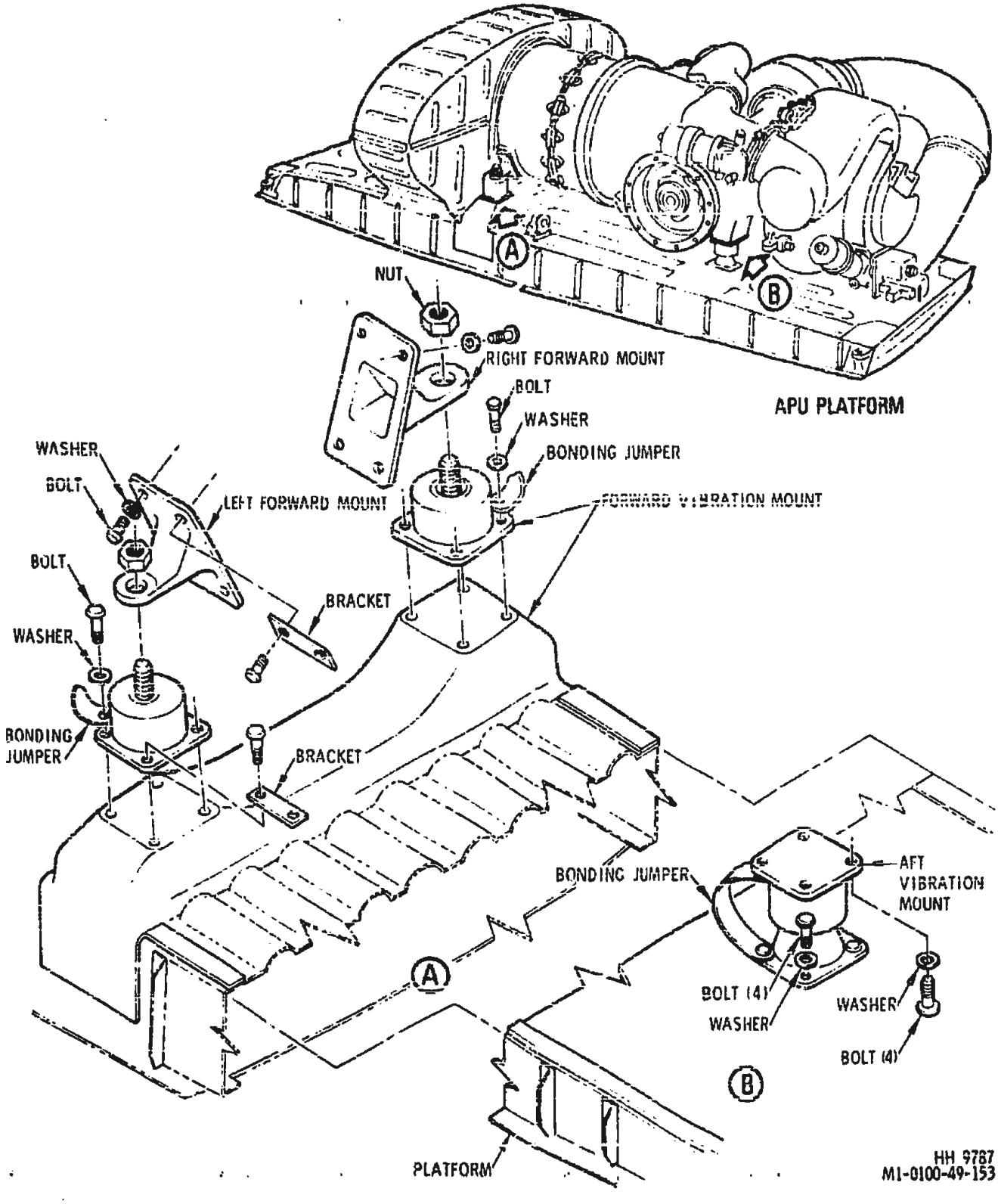
R (1) Attach forward vibration mount to engine mount pad as
R follows (Ref. Fig. 401):

R (a) Apply antiseize thread compound to bolt threads.

R (b) Install washers on bolts and insert bolts through
R mount into engine mount pad.

R NOTE: Left forward mount requires a bracket in
R lieu of a washer between pad and bolt head,
R at rear outboard corner of mount.

R (c) Torque bolts 250 to 275 lb in.



R APU Forward Vibration Mount - Removal and Installation
R Figure 401

R (d) Lock-wire bolts.

R (2) Attach forward vibration mount to platform as follows:

R (a) Apply antiseize thread compound to bolts.

R (b) Install washers on bolts and insert bolts through
R forward mount base plate into platform.

R NOTE: Left mount uses a bracket in lieu of a
R washer.

R (c) Torque bolts 180 to 200 lb in.

R (d) Lock-wire bolts.

R (3) Remove lifting sling from APU.

R (4) Install APU (Ref. 49-00-01).

R # APU AFT VIBRATION MOUNT - REMOVAL AND INSTALLATION

R 1. Equipment and Materials

R Lifting sling - APU

R Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

R Antiseize Thread Compound, ESSO No. 1, or equivalent

R 2. Referenced Procedure

R 49-00-01 Auxiliary Power Unit (APU) - Removal and
R Installation

R 3. Removal/Installation

R A. Removal

R (1) Remove APU (Ref. 49-00-01).

R (2) Attach lifting sling to forward and aft hoist brackets
R on APU and transfer weight of engine to sling.

R (3) Remove bolts attaching vibration mount to pad on load
R hardware gearbox assembly (Ref. Fig. 401).

R (4) Remove bolts attaching vibration mount to platform.

R (5) Remove vibration mount.

R B. Installation

R (1) Attach aft vibration mount to load hardware gearbox
R (Ref. Fig. 401) as follows:

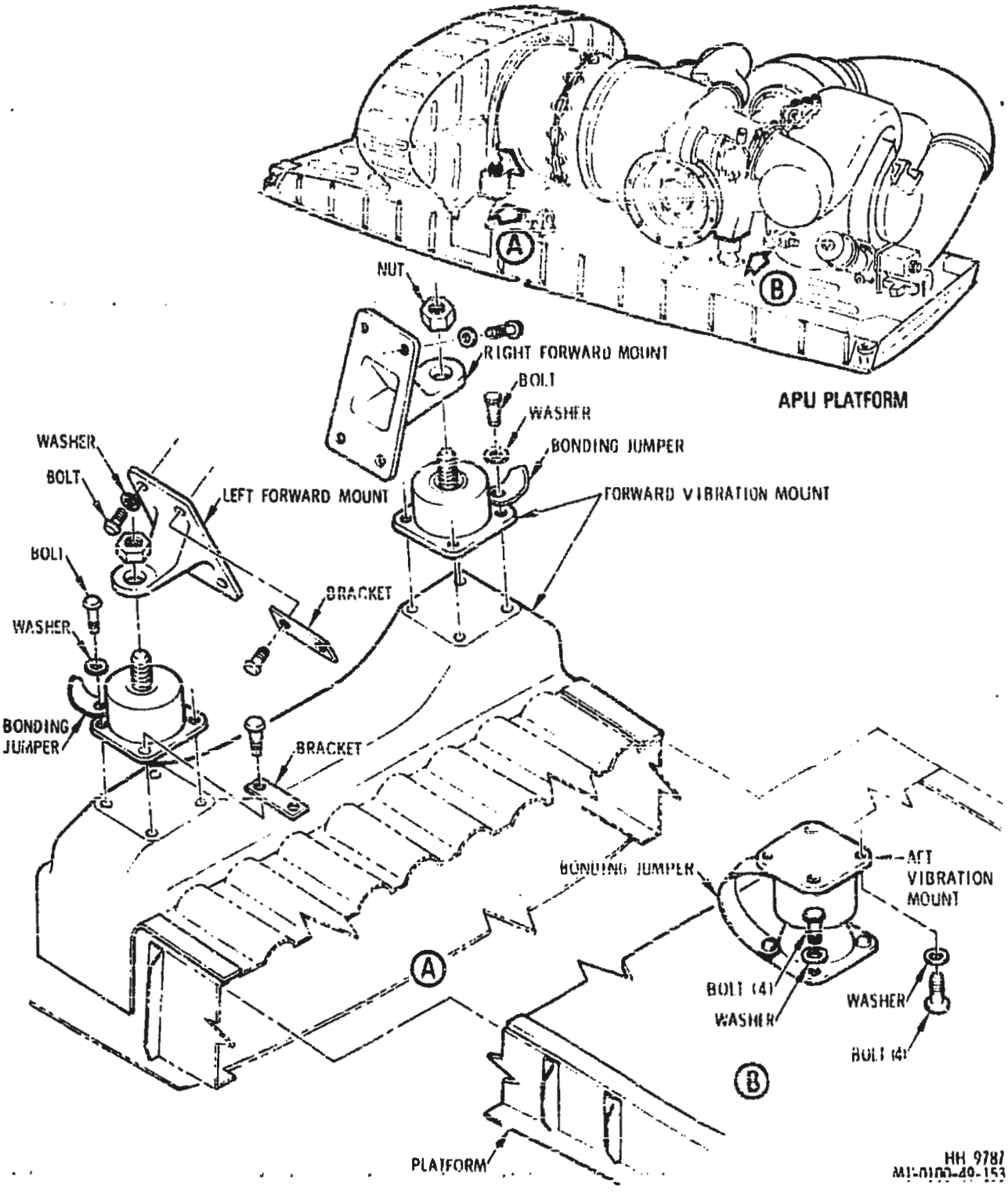
R (a) Apply antiseize thread compound to bolt threads.

R (b) Insert bolts through vibration mount and attach to
R load hardware gearbox assembly.

R (c) Torque bolts 6.5 to 60 lb in. (initial torque
R before bolts contact bracket installation).

R (d) Torque bolts 180 to 200 lb in. above initial
R installation torque.

R (e) Lock-wire bolts.



CR APU Engine Forward and Aft Vibration Mounts
CR Removal and Installation
CR Figure 401

R (2) Attach aft vibration mount to platform as follows:

R (a) Apply antiseize thread compound to bolt threads.

R (b) Insert external wrenching bolts with washers
R through vibration mount base into platform
R attachment.

R (c) First torque bolts 9.5 to 80 lb in., and then
R torque bolts 250 to 275 lb in. above initial
R installation torque. Lock-wire bolts.

R (d) Remove lifting sling from APU.

R (e) Install APU in aircraft (Ref. 49-00-01).

APU AIR INLET DOOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

Block, 2 by 4 by 23 inches, soft wood

Lock-wire, Fed Spec QQ-W-390, 0.020-inch diameter, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Tape, Paper-masking, Pressure-sensitive, 3M Company, or equivalent

2. Referenced Procedure

24-41-00 External Power/Ground Service System - Maintenance Practices

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag the following APU BAT
R BUS and APU POWER circuit breakers:

IGNITION (S11)

CONT POWER (S12)

POWER CONTROL (S13)

BAT PWR (B10)

APU T/R PWR (B11)

(2) Ensure MASTER POWER switch on APU CONTROL panel, zone 215, is in the OFF position and attach a Maintenance-in-Progress tag to the switch.

(3) Open access panels 319AL and 319BR to gain access to the forward end of the APU.

WARNING: MAKE CERTAIN THAT APU HAS COOLED SUFFICIENTLY
R AFTER SHUTDOWN TO PERMIT SAFE SKIN CONTACT.

R (4) Open the access plate on the right side of the actuator
R support and use a 1/4 inch drive ratchet with extension

R R to drive the door closed. Stop the door with trailing edge flush with the platform skin.

R R R (5) Apply several strips of masking tape across the gaps between the door and platform to support the door as it is disconnected.

R (6) Remove four bolts which retain the pivot actuator brackets to the engine air inlet door (Ref. Fig. 401).

R (7) Remove eight bolts and washers which retain the actuator support to the top of the platform.

R (8) Remove the APU wiring harness retaining clips, as necessary, to permit removal of the actuator from the platform opening.

R (9) Lay the actuator assembly out of the way on the platform.

(9) Work through the opening in the top of the platform and remove bolt and washer from each hinge.

R (11) Remove the tape and the air inlet door from the platform. Remove all tape from both parts.

R (12) Remove the bolts retaining each hinge bracket to the door. Retain brackets to use on the new door.

NOTE: Do not remove the hinges if the same door is to be reinstalled.

B. Installation

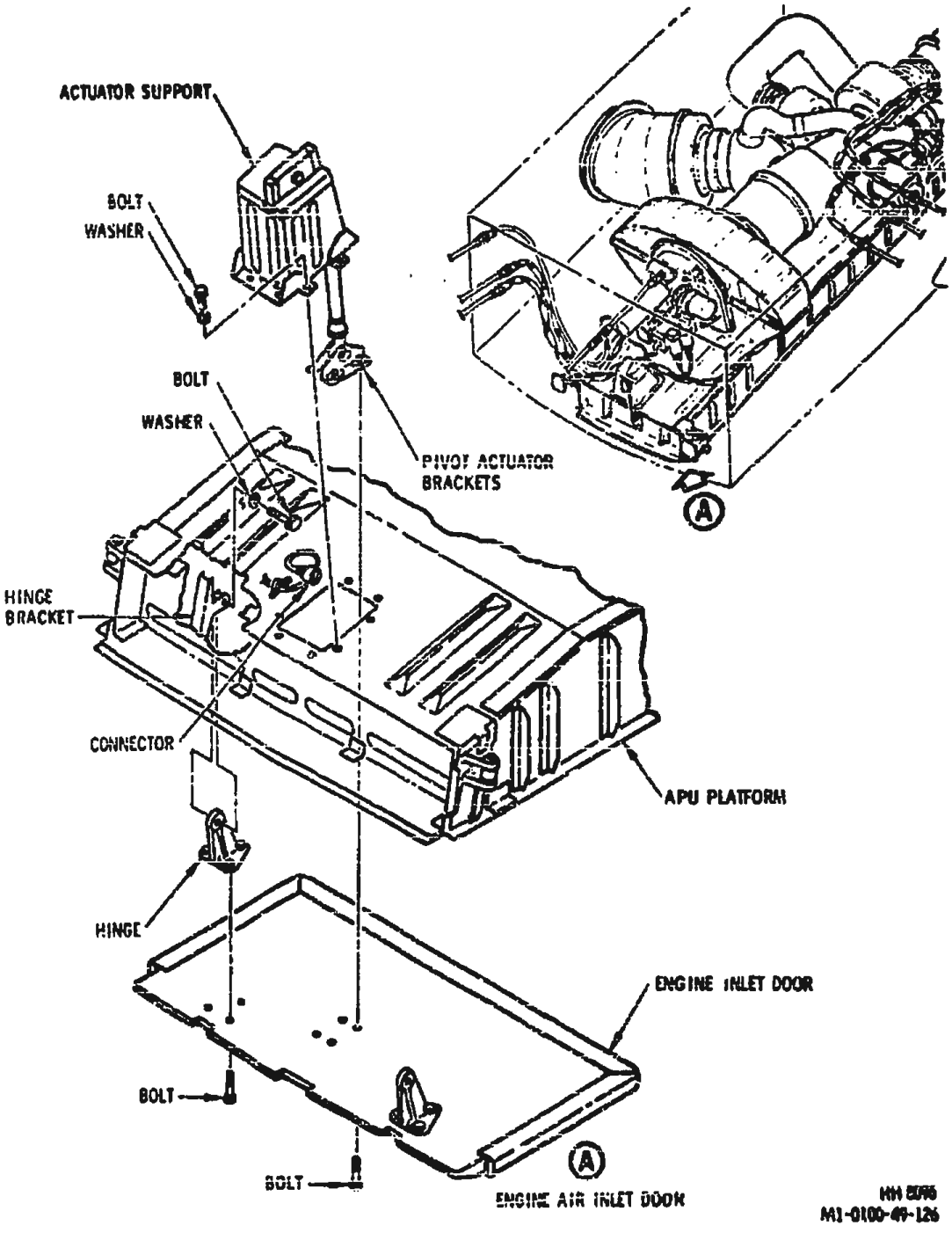
(1) Assemble the two hinge brackets to the inlet door. Tighten the retaining bolts on each bracket.

NOTE: The bracket bases are beveled. Install brackets with the thinner edge outboard.

(2) Place the engine air inlet door in position, simultaneously aligning the holes in the hinge brackets with the fixed portions of the hinges.

(3) Work through the opening in the top of the platform and install bolt and washer in each hinge. Torque the bolts 15 to 20 lb in. above installation torque.

(4) Block the engine air inlet door in the fully open position, using suitable wooden blocks.



CR APU Air Inlet Door - Removal and Installation
CR Figure 401

EFFECTIVITY: ALL

001B

(5) Place the actuator assembly in position in the platform opening, align the pivot actuator brackets with the holes in the door and install and torque the bolts.

(6) Support the door and carefully remove the blocks. Let the door return gently to the closed position.

(7) Align the actuator support with the mounting holes in the platform and install four bolts and washers, one in each side of the support.

(8) Check the alignment between the aft edge of the air inlet door and the lower platform skin. The door and skin must align within ±0.03 inch. Remove actuator and adjust the length in accordance with the following steps if the alignment is not within tolerance.

(a) Remove the bolts holding the pivot actuator brackets to the door.

(b) Remove the bolts and washers holding the actuator support to the platform.

(c) Lift the actuator assembly from the platform opening.

(d) Remove cotter pin, nut, hex head bolt, and flat washers from the pivot actuator brackets.

(e) Loosen the jack end fitting jam nut.

(f) Adjust the actuator jack end fitting, as required, and tighten the jam nut. Check that the end fitting alignment is correct and lock-wire the jam nut.

NOTE: One-half turn of the jack end fitting will move the door trailing edge approximately 0.016 inch.

(g) Assemble the pivot actuator brackets on the shaft end of the actuator with the flanges facing outward. Install a washer under the bolt head and at least one washer under the nut. Shim with additional washers as needed to obtain engagement of the cotter pin.

(h) Ensure that the bracket flanges are parallel, tighten nut, and install cotter pin.

(i) Reinstall the actuator assembly in accordance with Steps (4) through (7) and recheck alignment of door. Repeat adjustment if necessary.

(9) Install remaining bolts and washers in the actuator support. Torque and lock-wire all bolts.

(10) Reinstall the APU wiring harness clips removed during the removal procedure.

(11) Check area to be sure all tools and loose material are removed. (12) On the right side of the actuator support, use a 1/4 inch drive ratchet with extension to drive the air inlet door open, then close the access cover plate.

(13) Close and secure the APU access panels.

(14) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, remove tag and close circuit breakers opened in Step 3A.

APU AIR INLET DOOR ACTUATOR - MAINTENANCE PRACTICES

1. General

The following procedure specifies the method used to deactivate an inoperative APU air inlet door actuator.

2. Referenced Procedure

6-40-00 Exterior Access Doors and Panels

CR 3. Deactivation Deleted by M.O. 99746

APU AIR INLET DOOR ACTUATOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

Block, 2 by 4 by 23 inches, soft wood

Lock-wire, Fed Spec QQ-W-390, 0.020-inch diameter, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Sealant, RTV154, or equivalent (RTV128 is an approved equivalent). General Electric, Silicone Products Business Dept, Waterford, N.Y. (12188)

Solvent, ELECTROKLEEN, or equivalent. Swish Aerosol Electrokleen, Montgomery Chemical Co., 1300 Frog Hollow Rd, Jenkintown, Penn. (19046)

2. Referenced Procedure

24-41-00 External Power/Ground Service System - Maintenance Practices

49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag the following APU BAT BUS and APU POWER circuit breakers:

R FIREWALL SHUTOFF - PRIM (S7)

IGNITION (S11)

CONT POWER (S12)

BAT PWR (B10)

APU T/R PWR (B11)

(2) Verify that APU MASTER POWER switch on APU CONTROL PANEL, zone 215, is in the OFF position and attach a Maintenance-in-Progress tag.

(3) Open APU compartment access doors 319AL and 319BR.

R R R (4) Open the access plate on the right side of the actuator support and use a 1/4 inch drive ratchet with extension to drive the air inlet door closed.

R (5) Remove four actuator pivot bracket-to-air inlet door attach screws (Ref. Fig. 401).

R (6) Remove eight actuator support-to-platform attach screws and washers.

R (7) At top of actuator support, remove and discard actuator pivot bolt cotter pin. Remove pivot bolt, washers, and nut.

R (8) Using phenolic or plastic scraper, remove bead of RTV154 sealant installed around base of actuator support and wiring harness cutout.

R (9) Remove actuator support.

R (10) Disconnect wiring harness plug JP8 from the actuator and remove actuator.

R (11) Remove door attach brackets. Discard cotter pin and retain pivot bolt, washers, and nut.

B. Installation

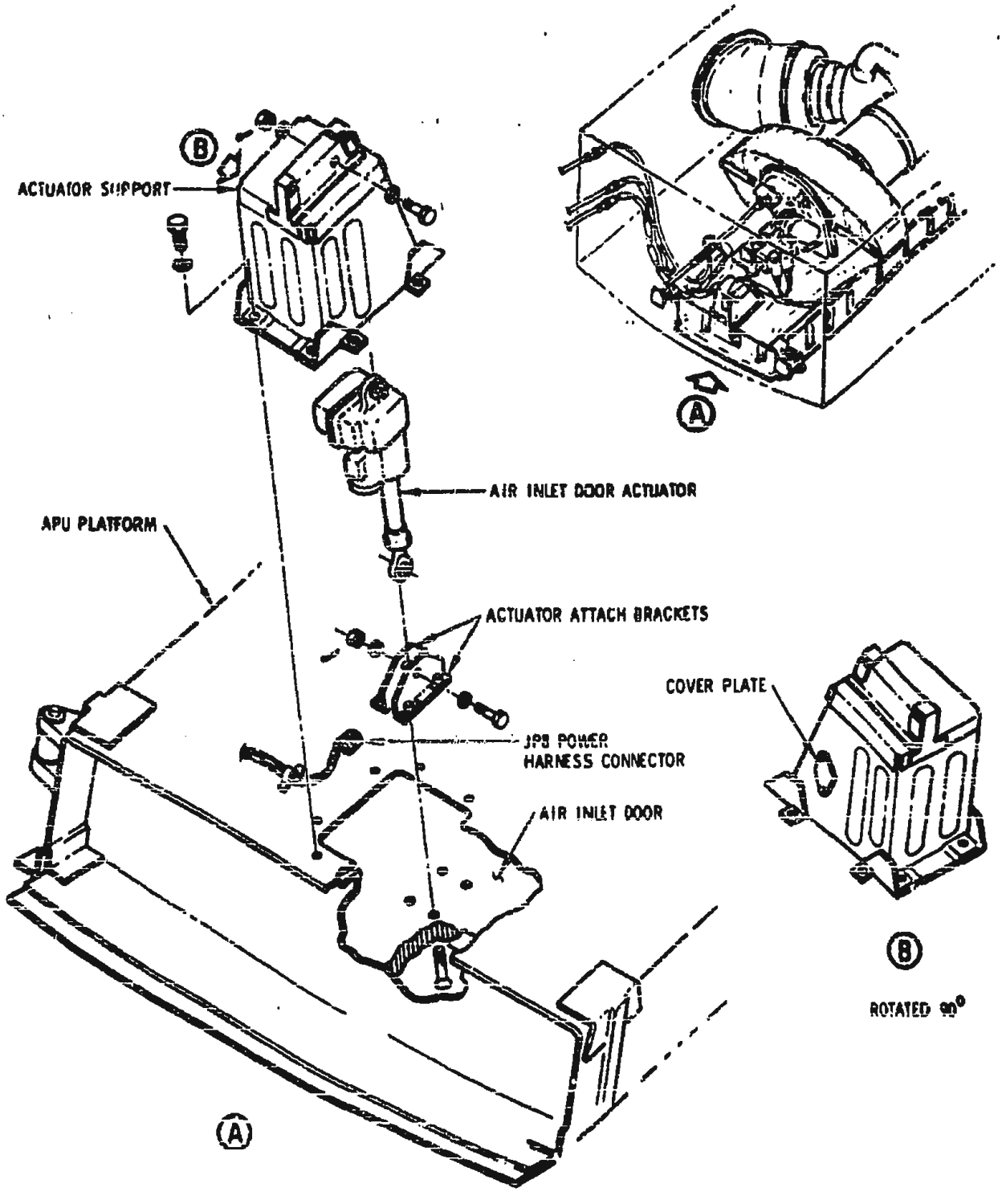
(1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

(2) Verify that APU MASTER POWER switch is in the OFF position and tagged.

R (3) Measure distance between centerlines of actuator pivot bolt holes. This dimension must be 11.55 (±0.3) in. If necessary, adjust actuator rod end fitting to obtain desired length. (One-half turn of rod end fitting will change actuator length 0.016 in.)

R (4) Install actuator-to-door pivot brackets on the shaft end of the actuator with bracket flange facing outward. Install pivot bolt with one washer under bolt head and one or more washers under attach nut as necessary to align cotter pin hole when nut is torqued 15 to 20 lb. in. Install cotter pin.

R (5) Assemble upper end of actuator to the actuator support with the manual crank shaft aligned with the cover plate on the side of the support. Install pivot bolt with one washer under bolt head and one or more washers under attach nut as necessary to align cotter pin hole



M1-0101-49-125

APU Air Inlet Door Actuator - Removal and Installation
Figure 401

when attach nut is torqued 15 to 20 lb. in. Install cotter pin.

R (6) Connect the APU wiring harness plug JP8 to the actuator and install lock-wire.

R (7) Block the engine air inlet door in the fully open position, using suitable wooden block.

R (8) Install actuator rod end in opening in platform and align the actuator pivot brackets with the holes in the door. Install bracket-to-door attach screws.

R (9) Carefully remove door block and lower inlet door to the closed position.

R (10) Align the actuator support with the mounting holes in the top of the platform with wiring harness positioned
R in cutout. Install eight actuator support attach
R washers and screws.

R (11) On right side of actuator support, use a 1/4 inch drive
R ratchet with extension to drive the air inlet door to
R the full open position, and then close the access
R plate.

R (12) Check area to be sure all tools and debris are removed.

R (13) Remove tags and close circuit breakers opened in Step
R 3A(1).

R (14) Clean the area around the base of the actuator support using a cloth dampened with ELECTROKLEEN (or equivalent) solvent. Apply a bead of RTV154 (or equivalent) sealant around the base of the actuator support. Completely seal cutout opening where wiring harness if routed into actuator support and any openings that would permit passage of fluids into the actuator support.

R (15) Close forward APU access doors and rotate fluid scupper catcher aft against compartment access door.

DRIP TANK - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Preformed packing (Ref. Fig. 401)

Drain Pan

2. Removal/Installation

A. Removal

(1) On Flight Engineers/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker APU BAT BUS - CONT PWR.

(2) Open APU compartment access doors 319BR and 319DR.

(3) Remove drain plug from drip tank and empty tank (Ref. Fig. 401). Replace drain plug.

(4) Loosen strap clamps on drain hoses and disconnect hoses.

(5) Remove screws attaching tank to platform.

B. Installation

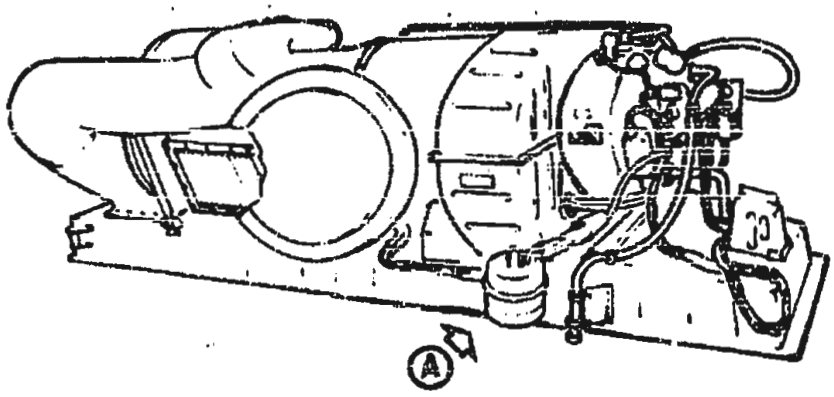
(1) Verify that circuit breaker opened in Step 2A(1) is open and tagged.

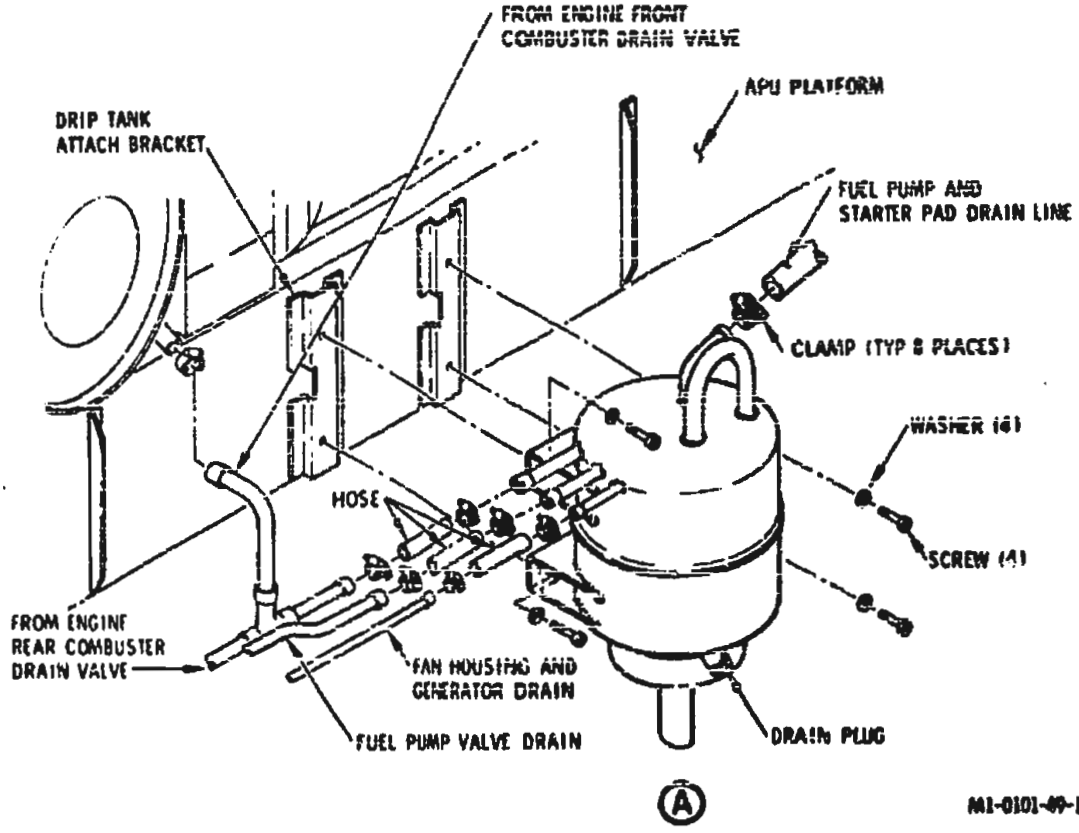
(2) Attach tank to APU platform with screws and washers. Lock-wire screws.

(3) Connect drain hoses to drip tank and tighten strap clamps.

(4) Tighten drain plug on drip tank.

(5) Remove tag and open circuit breaker closed in Step 2A(1).





R

Drip Tank - Removal and Installation
Figure 401

APU COMPARTMENT VENTILATION SHUTOFF VALVE REMOVAL AND INSTALLATION

R NOTE: The APU compartment ventilation shutoff valve is
R electrically deactivated in the closed position on all
R aircraft having the unit installed (Ref. SB49-053).

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Control Column and Trim Wheel Lock BA80-101 (Ref. G/ITEL 27-41-01)

2. Referenced Procedures

24-41-00	External Power/Ground Service System - Maintenance Practices
49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers B9 through B11.

CAUTION: BEFORE ENTERING AFTERBODY AREA, ZONE 316, INSTALL CONTROL COLUMN AND TRIM WHEEL LOCK BA80-101 (REF. G/ITEL 27-41-01).

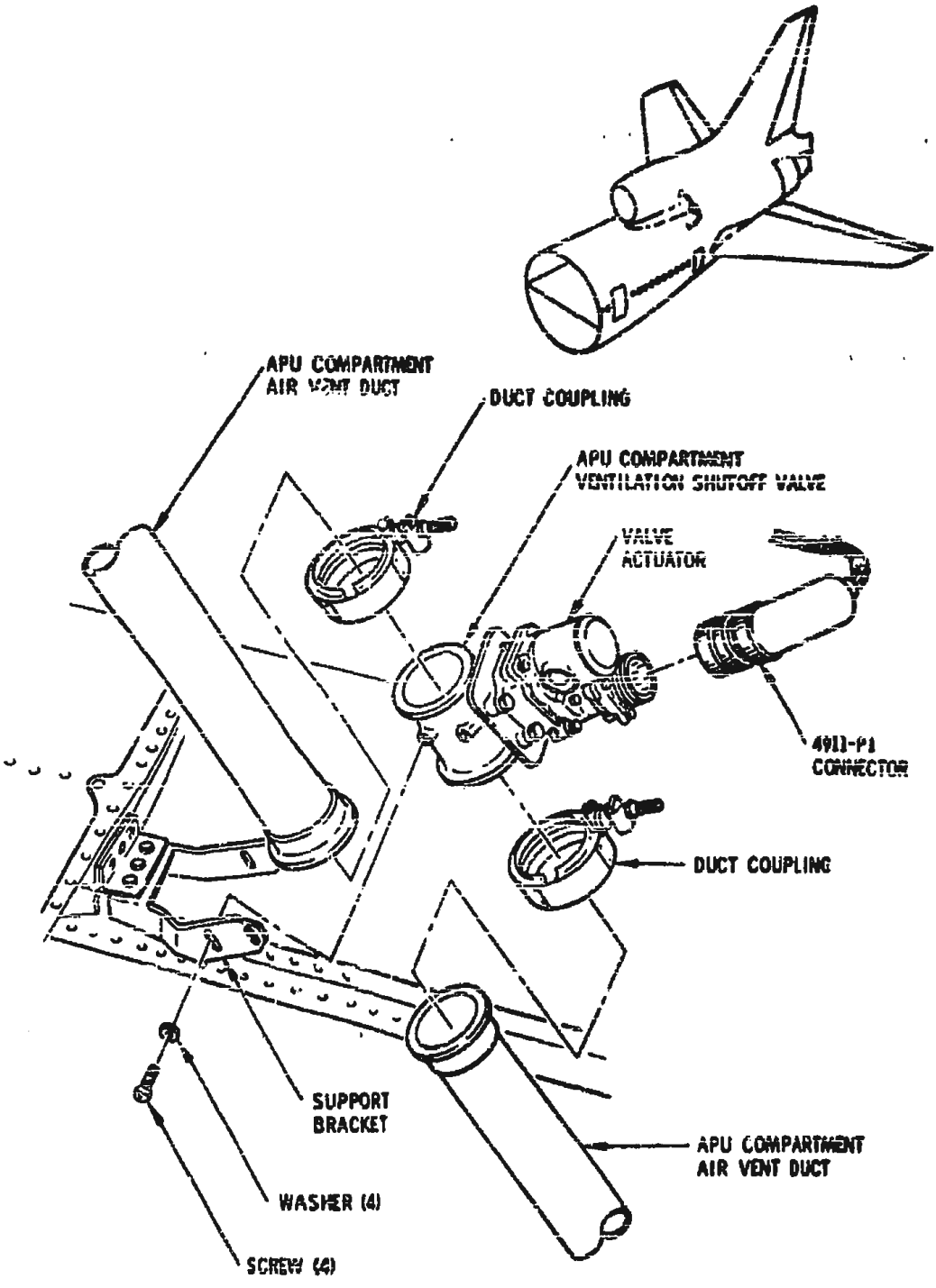
(2) Enter afterbody area by opening access door 317BB.

(3) Disconnect electrical connector 4911-P1 (Ref. Fig. 401).

(4) Remove four valve body-to-support bracket attach screws and washers.

(5) Remove two valve-to-air vent duct couplings and remove valve.

B. Installation



M1-0100-49-511

APU Compartment Ventilation Shutoff Valve
Removal and Installation
Figure 401

CAUTION: BEFORE ENTERING AFTERBODY AREA, ZONE 316, VERIFY THAT CONTROL COLUMN AND TRIM WHEEL LOCK BA80-101 IS INSTALLED.

(1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

(2) Position valve between flanges of upper and lower air vent ducts with flow arrow on valve body pointing upward toward vent duct outlet.

(3) Install valve body-to-support bracket attach screws and washers. Do not tighten screws at this time.

(4) Install valve-to-air vent duct couplings, then tighten valve body-to-support bracket screws and add lock-wire.

(5) Install 4911-P1 electrical connector and add lock-wire.

R (6) Verify that valve is closed, if not, move valve
R position lever to the closed position and secure with
R lock-wire.

(7) Close access door 317BB.

(8) On FE/SO aft circuit breaker panel CB3, zone 215, remove tags and close APU POWER circuit breakers B9 through B11.

(9) Remove control column and trim wheel lock BA80-101.

R AIR VENT EJECTOR ACTUATOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed. Spec. QQ-W-390, 0.020 diameter, or equivalent

2. Removal/Installation

A. Removal

(1) Ensure that APU MASTER POWER switch on Flight Engineer/Second Officers APU CONTROL panel, zone 215, is in the OFF position. Attach a Maintenance-In-Progress tag to the switch.

(2) Open APU access doors 319 BR and 319 DR.

(3) Remove electrical connector from vent ejector actuator (Ref. Fig. 401).

(4) Support actuator arm and remove actuator arm bolt and washer from clevis.

(5) Support actuator and remove nut, bolt, and two spacers from actuator bearing support. Withdraw actuator arm from clevis and remove actuator.

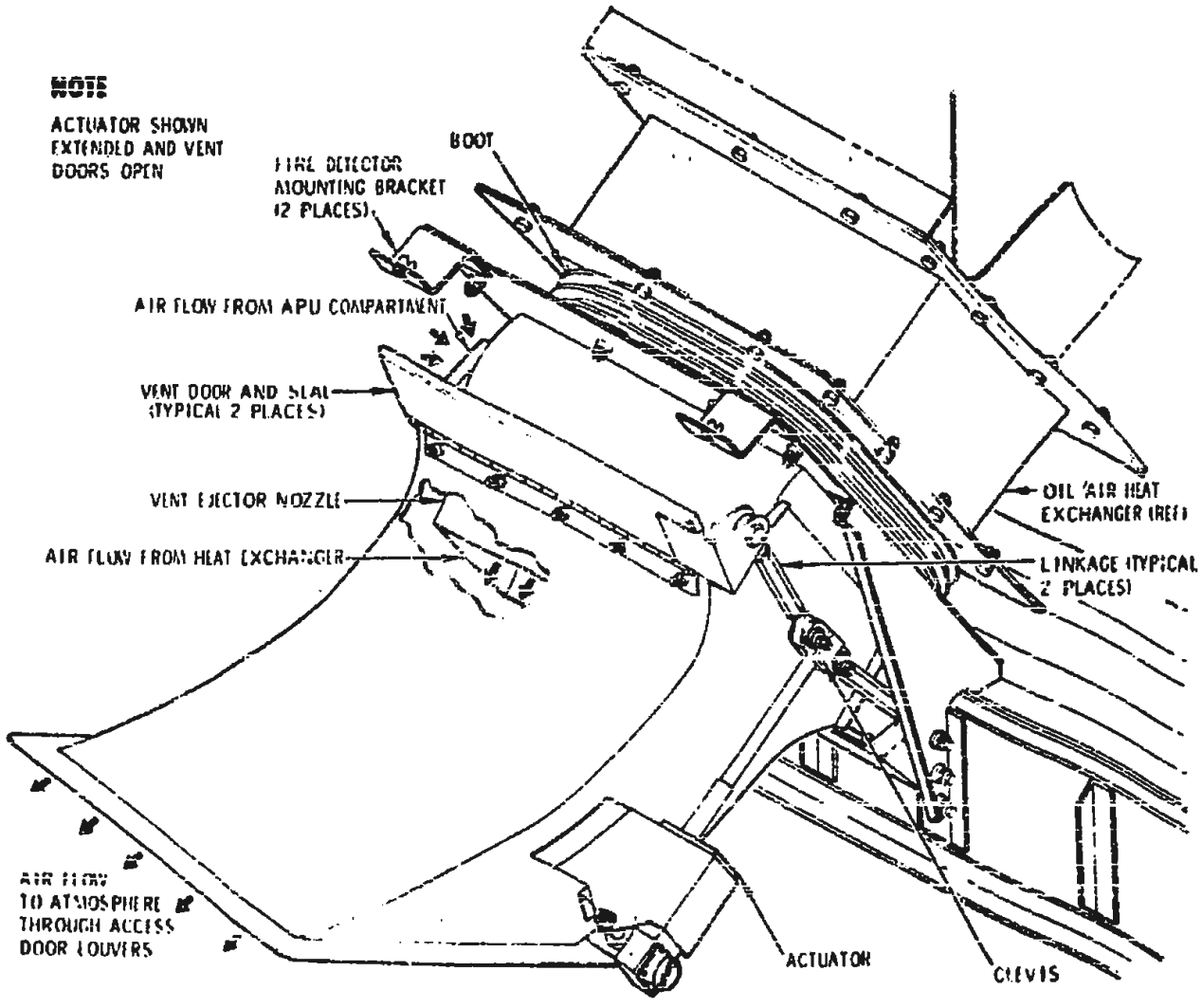
B. Installation

(1) Place vent ejector actuator in position in ejector support bracket. Position spacers on either side of actuator bearing support. Install bolt and nut and torque nut.

(2) Connect electrical connector and support actuator so that the drive end is free to move in or out.

CAUTION: IF VENT ACTUATOR IS NOT COMPLETELY RETRACTED, IT WILL ENERGIZE WHEN THE APU MASTER POWER SWITCH IS SELECTED TO ON POSITION. DO NOT OPERATE THE START SWITCHLIGHT.

(3) On the APU CONTROL panel, place the APU MASTER POWER switch in the ON position. If the vent actuator was extended, it will energize and move to the fully retracted position. After approximately 15 seconds, place the APU MASTER POWER switch in the OFF position.


NOTE
ACTUATOR SHOWN EXTENDED AND VENT DOORS OPEN
BOOT
FIRE DETECTOR MOUNTING BRACKET (2 PLACES)
AIR FLOW FROM APU COMPARTMENT
VENT DOOR AND SEAL (TYPICAL 2 PLACES)
VENT EJECTOR NOZZLE
AIR FLOW FROM HEAT EXCHANGER
OIL/AIR HEAT EXCHANGER (REF)
LINKAGE (TYPICAL 2 PLACES)
AIR FLOW TO ATMOSPHERE THROUGH ACCESS DOOR LOUVERS
ACTUATOR
CLEVIS

A11-A01-49 002

R
R

APU Vent Ejector Assembly
Figure 401

EFFECTIVITY: ALL

001B

(4) Loosen locknuts on both turnbuckles. Turn the turnbuckles to lengthen linkage approximately 1/4 inch.

CAUTION: ENSURE THAT VENT DOORS ARE NOT BEING FORCED AGAINST MATING SURFACES WHEN INSTALLING CLEVIS BOLT. IF A FORCED FIT IS SUSPECTED, INCREASE TURNBUCKLE LENGTH AS REQUIRED.

(5) Support actuator and move vent door linkage so clevis slides into place over actuator drive arm. Secure clevis in place with bolt and washer. Lengthen linkage as required to avoid over compression of door seals. Torque bolt.

(6) Perform the following on both turnbuckles:

R (a) Turn the turnbuckle to lengthen linkage until vent door seal is no longer contacting vent duct surface.

R (b) Slowly turn the turnbuckle to shorten linkage until vent door seal is just contacting vent duct surface around complete perimeter. Then, turn the turnbuckle two more turnbuckle flats to compress seal.

R (c) Ensure that rod ends are aligned (to prevent binding); torque locknuts and lock-wire.

(7) Remove all tools and equipment from APU compartment. Close and lock access doors.

(8) Remove Maintenance-In-Progress tag from APU MASTER POWER switch in flight station.

AIR VENT EJECTOR ASSEMBLY - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed. Spec. QQ-W-390, 0.020-inch diameter, or equivalent

2. Referenced Procedure

49-11-18 Air Vent Ejector Actuator - Removal and Installation

3. Removal/Installation

A. Removal (Air Vent Ejector)

(1) Ensure that the APU master power switch on the Flight Engineer/Second Officers APU CONTROL panel, zone 215, is in the OFF position. Attach a
R Maintenance-In-Progress tag to the switch and APU FIRE
R PULL handle.

R (2) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag APU POWER circuit
R breakers B9 through B16.

(3) Open right APU compartment access doors 319 BR and 319 DR.

(4) Disconnect vent ejector actuator electrical connector (Ref. Fig. 401).

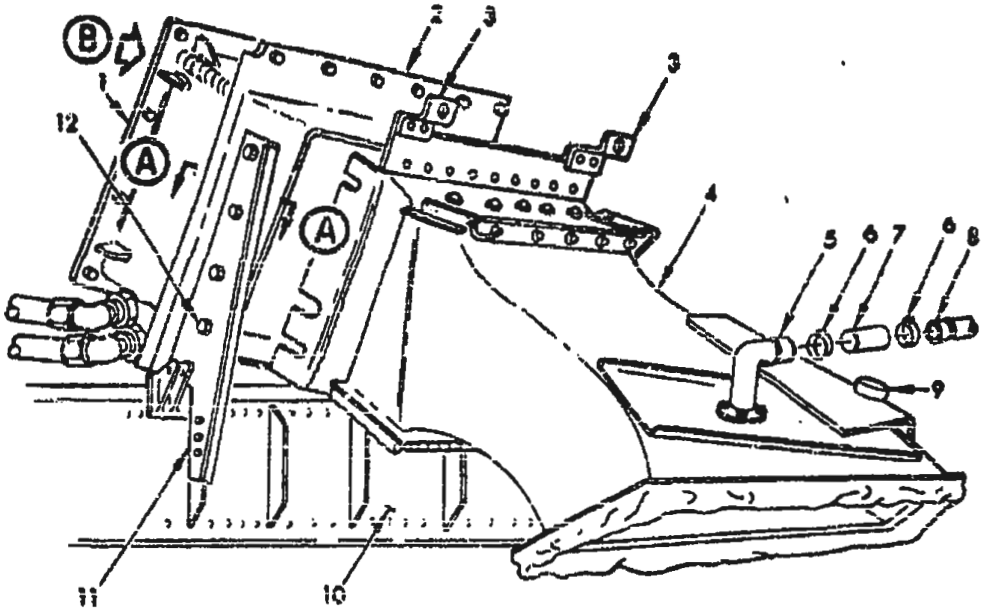
(5) Disconnect fire detector harness by releasing two quick-disconnect fasteners. Temporarily support fire detector harness with tape or string.

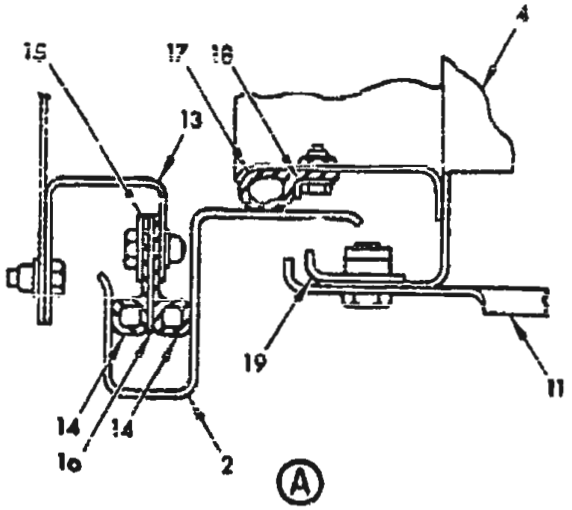
(6) Disconnect engine breather hose.

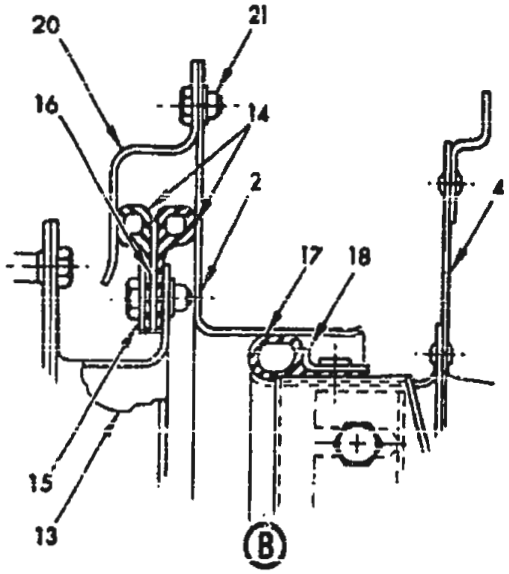
(7) Loosen four ejector duct support screws on each support bracket and remove the ejector assembly.

(8) If applicable, remove air vent ejector actuator (Ref. 49-11-18).

B. Installation (Air Vent Ejector)







1	OIL-TO-AIR HEAT EXCHANGER (REF.)	12	EJECTOR SUPPORT SCREW (4 EACH THROUGH ITEM 11 INTO NUT PLATES ON ITEM 19
2	EJECTOR DUCT GUIDE	13	EJECTOR SUPPORT
3	FIRE DETECTOR HARNESS SUPPORT (2)	14	EJECTOR GUIDE SEAL
4	AIR VENT EJECTOR	15	GUIDE SEAL CLAMP
5	ENGINE BREATHER FITTING	16	GUIDE SEAL RETAINER
6	CLAMP	17	EJECTOR DUCT SEAL
7	HOSE	18	CLAMP (EJECTOR DUCT SEAL)
8	ENGINE BREATHER LINE	19	EJECTOR SUPPORT CLAMP
9	ELECTRICAL RECEPTACLE	20	CLAMP (EJECTOR GUIDE SEAL)
10	APU PLATFORM (REF.)	21	CLAMP ATTACH SCREW, WASHER, NUT M1-0101-~~69-457~~
11	EJECTOR SUPPORT BRACKET (2)		

R Air Vent Ejector Assembly - Removal and Installation
R Figure 401

EFFECTIVITY: ALL

0018

(1) If applicable, install the air vent door actuator and perform preliminary adjustments to door actuating linkage (Ref. 49-11-18).

(2) Insert the air vent ejector duct into the ejector duct guide (Ref. Fig. 401) with the slotted flanges on the ejector duct between the support bracket surfaces and the ejector support clamps (Ref. Fig. 401). Be sure slotted flanges of the ejector assembly are fully seated, then tighten the four ejector support screws in both support brackets.

(3) Attach fire detector harness to support clips on vent ejector assembly.

CAUTION: BE CERTAIN THAT THERE IS AT LEAST 1/4-INCH CLEARANCE BETWEEN THE FIRE DETECTOR SENSOR AND EXHAUST DUCT AND BETWEEN THE SENSOR AND UPPER AIR VENT EJECTOR DOOR WHEN IT IS FULLY OPEN.

(4) Connect engine breather hose to standpipe on air vent ejector.

(5) Close aft right APU compartment access door and visually check sealing of ejector duct seal against door. Seal must be compressed against door at all locations. If not, loosen ejector support screws (Ref. Fig. 401) and reposition the ejector duct as necessary to seat the seal against the door. Retighten the ejector support screws.

(6) Remove tags and close circuit breaker opened in Step 3(A)2.

(7) Check operation and adjustment of ejector door linkage (Ref. 49-11-18).

(8) Install actuator cover.

(9) Close APU compartment access doors.

(10) Remove Maintenance-In-Progress tag from APU MASTER POWER switch.

C. Removal (Air Vent Ejector Support and Guide Assembly)

A rectangular sheet metal ejector support and guide assembly bolted to the oil-to-air heat exchanger serves as an ejector assembly-to-heat exchanger adapter. Removal of the support and guide is not necessary if only the ejector assembly is being replaced. However, if the parts are required for installation on another APU, proceed as follows:

(1) Remove air vent ejector assembly (Ref. Step 3(A).

(2) Remove ejector support bracket to platform fasteners (Ref. Fig. 401).

NOTE: If a spacer is installed between the bracket tab and platform clip, retain the spacer for possible use during reinstallation. The spacer accommodates a dimensional tolerance variance at this location and may, or may not, be required on another APU GEC build-up.

(3) Remove ejector support and guide assembly to heat exchanger fasteners and separate the support and guide assembly from the heat exchanger.

NOTE: If the ejector guide assembly seals require replacement, remove the ejector guide seal clamp fasteners installed along the upper edge of the assembly and remove the clamp. With the guide seal clamp removed, the ejector duct guide can be separated from the ejector support (Ref. View B). New seals may be fabricated from LS 14995 seal stock using the removed seals as patterns. Attach the seals to the outer support flange (Ref. View A). Reassemble the ejector duct guide to the support and reinstall the seal clamp.

D. Installation (Air Vent Ejector Support and Guide Assembly)

(1) Attach the ejector guide and support assembly to the heat exchanger (Ref. Fig. 401).

(2) Install the ejector assembly support bracket to platform fasteners.

(3) Install the air vent ejector (Ref. Step 3B).

APU COMPARTMENT INSULATION BLANKET - APPROVED REPAIRS

1. General

The following procedure includes a method by which tears and gouges in the outer foil of APU compartment insulation blankets may be repaired while installed in the aircraft. The repair procedure mechanically fastens a patch of identical material to the blanket surface over a cutout made to remove the damaged area. A fireproof insulating compound is applied to prevent wicking of fluids into the blanket insulating material.

2. Equipment and Materials

R Foil, AMS5510 (Ribbed) Type 321, 0.002 in. thick, 1/4 Hard CRES (Arrowhead Products Division, Federal-Mogul Corp. 4411 Kateila Ave., Los Alamitos, California 90720)

Insulation, 1/2 in. thick, 6 lb/cu ft KOA Wool Batting (Babcock & Wilcox Co. P.O. Box 923, Old Savannah Rd. Augusta, Ga. 30903)

LAC C-40-745A Fireproof Insulating Compound (Stabond Corporation, 14000 S. Western Ave. Gardena, Calif. 92249)

Staples (1/2 in.) (Locally Procured)

3. Approved Repairs

A. APU Compartment Insulation Blanket

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers B9 through B15.

(2) Attach MAINTENANCE-IN-PROGRESS tag to MASTER POWER switch on APU CONTROL panel.

(3) Open APU compartment access doors, zone 319.

(4) Make rectangular cutout in outer foil of blanket just large enough to remove the damaged area (Ref. Fig. 801).

(5) Make angular cuts at each corner of cutout. Fold up each edge of cutout to make a 1/2 in. (12.7 mm) flange at right angles to the blanket.

(6) Replace any missing or fluid soaked insulation batting.

R (7) From 0.002 in. AMS5510 CRES foil, cut a rectangular patch 1.0 in. (25.4 mm) larger in both width and length than the cutout in the blanket. Remove a 1.0 in. (25.4 mm) square area at each corner. Fold up the edges of the patch to form a 1/2 in. (12.7 mm) folded fel flange as shown on Figure 801.

(8) Throughly clean both sides of cutout and patch flanges using methyl cellosolve acetate or toluene.

(9) Apply a film of LMS 40-745A fireproof insulating compound on both sides of the blanket cutout flanges.

(10) Set patch in place with the cutout flanges inserted into the folded fell flanges of the patch.

(11) Fasten the patch to the blanket using 1/2 in. (12.7 mm) width staples driven approximately 1.0 in. (25.4 mm) on center.

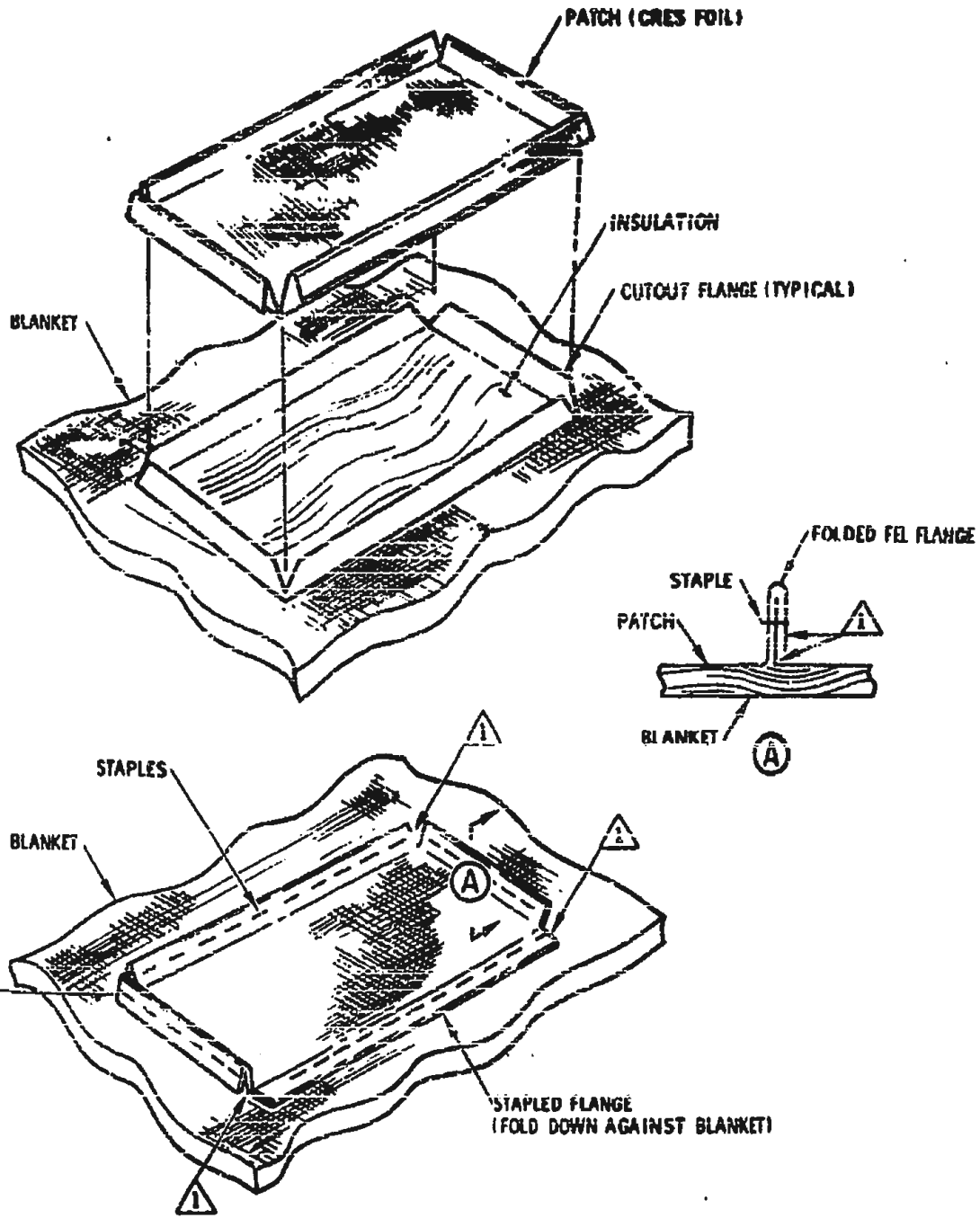
(12) Fold the patch flanges down against the blanket being certain that all horizontal flanges in repairs made to vertically installed blankets are bent downward.

(13) Apply LMS 40-745A fireproof insulating compound at each corner of the patch and along all edges of the patch flanges as necessary to assure a fluid-tight installation.

(14) Close APU compartment access doors, making certain that the fluid fence catcher is swung aft against the compartment door.

(15) Remove tags and close circuit breakers opened in Step (1).

(16) Remove MAINTENANCE-IN-PROGRESS tag installed on APU CONTROL panel.



NOTE
1 LMS40-745A FIREPROOF INSULATING SEALANT

M1-0001-49-922

R APU Compartment Insulating Blanket Repair
R Figure 801

EFFECTIVITY: ALL

001B

ENGINE - DESCRIPTION AND OPERATION

1. General

R The ST6L-73 engine is a lightweight free turbine powerplant especially adapted to the APU as a gas generating power source. The engine consists of an integral compressor/power turbine and a reverse flow annular combustion chamber. The expanding engine exhaust gases drive an independent free turbine which mechanically drives an air load compressor, cooling fan, electrical generator, and a load hardware gearbox. All engine driven accessories are mounted to and driven by the load hardware gearbox (Ref. Fig. 1).

R The engine consists of the following major sub assemblies:

A. A power section consisting of the free turbine, free turbine power output shaft and support bearings, and exhaust duct assembly

B. A gas generator section comprised of the engine compressor/turbine spool, annular combustion chamber, gas generator case, and compressor air inlet case

C. The accessory gearbox

The accessory gearbox is considered the front of the engine (and APU) and faces forward when installed in the aircraft. Right and left direction and location references relate to the installed unit when viewed from the aft end of the APU compartment.

All engine-driven accessories are mounted on the accessory gearbox and driven by the engine compressor/turbine spool. The compressor/turbine spool is coupled to the gearbox by a connecting shaft which extends forward through a conical tube in the oil tank to the gearbox drive.

The engine is equipped with two lifting brackets for the attachment of a lifting sling. The forward bracket is secured to the accessory gearbox attach flange; the aft bracket is bolted to the exhaust duct flange. Two engine R mount pads bolted to the compressor air inlet case, support the forward end of the engine on two vibration isolating mounts attached to the APU mounting platform. The aft end of the engine is supported by the load hardware gearbox which is attached to the APU platform by a single vibration mount.

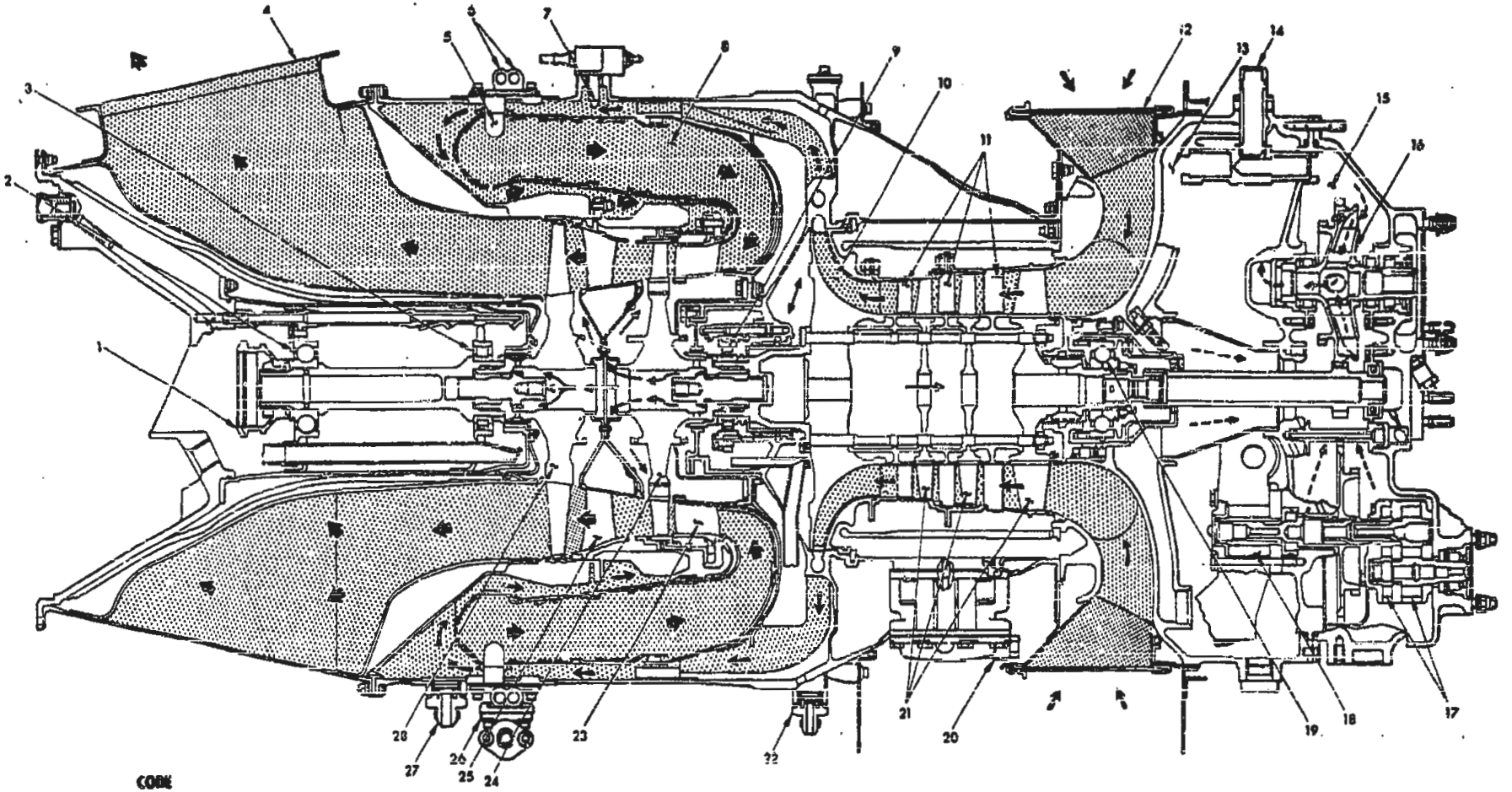
The engine ignition system consists of an ignition exciter
R mounted on the accessory gearbox, two igniters on the gas
R generator case, and an ignition harness. The ignition
R harness is connected to aircraft wiring by an electrical interface connector on the forward wall of the APU compartment (Ref. 49-41-00). An integrated chromel/alumel T1, T3, T7 engine temperature sensing harness, containing four dual element temperature sensing probes, is supported on the gas generator case by quick disconnect clips and terminated at two terminals on the P3 thermocouple probe. Two wires (part of the APU signal wiring harness) transmit the engine temperature signal to an aircraft electrical wiring interface connector on the forward wall of the APU compartment (Ref. 49-71-00).

Engine fuel system components mounted on the engine accessory gearbox include an engine-driven fuel pump containing a fuel filter, a fuel control unit, an automatic fuel shutoff valve assembly, and a P3 (compressor bleed air) line heater. Fuel is supplied to the engine through an oil-to-fuel heater attached to the accessory gearbox case. A fuel flow divider and dump valve at the bottom of the gas generator case divides the flow of fuel into two fuel manifolds encircling the engine combustion chamber and provides a drainage path for this fuel to a fuel collecting (drip) tank during engine shutdown. Fuel is injected into the combustion chamber by 14 fuel spray nozzles in the fuel manifolds (Ref. 49-31-00).

The engine lubricating oil supply is contained in an integral oil tank which forms part of the engine compressor air inlet case. An oil pressure pump mounted on the aft side of the accessory gearbox case supplies pressurized oil through an oil filter to a passage in the gearbox case from where it is distributed to the accessory gearbox, engine compressor bearings, power section bearings, and load hardware gearbox. A portion of the heated oil in this passage is continuously circulated through the oil-to-fuel heater to pre-heat fuel admitted to the fuel pump. Two dual element oil scavenge pumps, one mounted externally on the accessory gearbox case and the other internally in the gearbox, return engine lubricating oil to the oil tank through an air-to-oil heat exchanger.

A detailed description of the engine accessory gearbox, gas
R generator, and engine power section is contained in United
R Aircraft Canada Ltd. (UACL) ST6L-73 engine overhaul manual, 49-21-01.

APU engine leading particulars are listed in Table 1.



R Engine Cross Section and Air Flow Diagram
R Figure 1

EFFECTIVITY: ALL

0018

Engine Leading Particulars
Table 1

ITEM	CHARACTERISTIC
Engine Type	Gas Turbine (free turbine power output stage)
Max Power Rating and Specific Fuel Consumption	
Sea Level, 59°F (15°C) Sea Level, 103°F (40°C)	820 hp (0.585 lb/shp/hr) 720 hp (0.611 lb/shp/hr)
Combustion Chamber	Reverse Flow Annular
Compression Ratio	7.0:1
Free Turbine Rotation (Viewed From Aft End)	Counterclockwise
Free Turbine Speed (100%)	33,000 rpm
Dry weight	
Engine APU (QEC)	300 lbs 860 lbs
Gas Generator Operating Range	90 to 100% Ng
Gas Generator Speed (100%)	37,500 rpm
Cooling Fan Speed (99.5%)	32,689 rpm
Cooling Fan Output	160 lbs/min (Sea Level, 103°F day)
Gas Generator Speed	
Load Topping Maximum Trim	102% (38,250 rpm) 101.6% (38,100 rpm)
Gas Generator Trim Speed Range	36,500 to 38,100 rpm
Fuel Type	PWA 522-E
Oil Type	Ref. 12-12-41
Oil Quantity	2.3 US gals

Engine Leading Particulars (Cont)
Table 1

ITEM	CHARACTERISTIC
Normal Oil Consumption	0.5 to 2 qts (0.473 to 1.89 l)/100 hours
Max. Allowable Oil Consumption	5 qts (4.73 l)/100 hours
Operating Temp Range	700°C to 105°C (Turbine Inlet Temperature)
Overspeed Shutdown	110% Nf (Free Turbine Speed)
Ng Electronic Topping Range	36,500 to 38,100 rpm (97.0 to 101.6% Ng)
Ng Governor Limiting	38,500 to 38,850 rpm (102.6% Ng)

2. Engine Air Systems

A. Description and Operation

The APU engine incorporates three basic airflow systems, each using air from the main airflow stream through the engine compressor. These are the turbine disks and compressor turbine stator cooling system, the engine bearing compartment air seal system, and the compressor control air bleed system. In addition, engine compressor discharge air (P3) is ported to the fuel control unit through an external electrically heated tube assembly, and through a second external tube to the surge valve controller, surge control valve, and inlet guide vane actuator (Ref. 49-51-00). The engine airflow paths for the preceding three systems are shown in Figure 1 and described in detail in the UACL ST6L-73 engine overhaul manual, 49-21-01.

R 3. Engine Compressor Bleed Valve

R A. Description and Operation

R Gas generator compressor stalling during engine acceleration
R and deceleration is prevented by a compressor bleed valve
R mounted on the bottom of the engine compressor case. The
R valve automatically bypasses varying amounts of P2.5
R interstage compressor air back into the engine air inlet
R plenum, depending on the amount of P2.5 pressure and P3
R compressor discharge pressure that is applied to opposite

sides of a piston in the unit. The valve is normally fully closed when the engine is operating in the maximum power
R range and gas generator speed (Ng) is high.

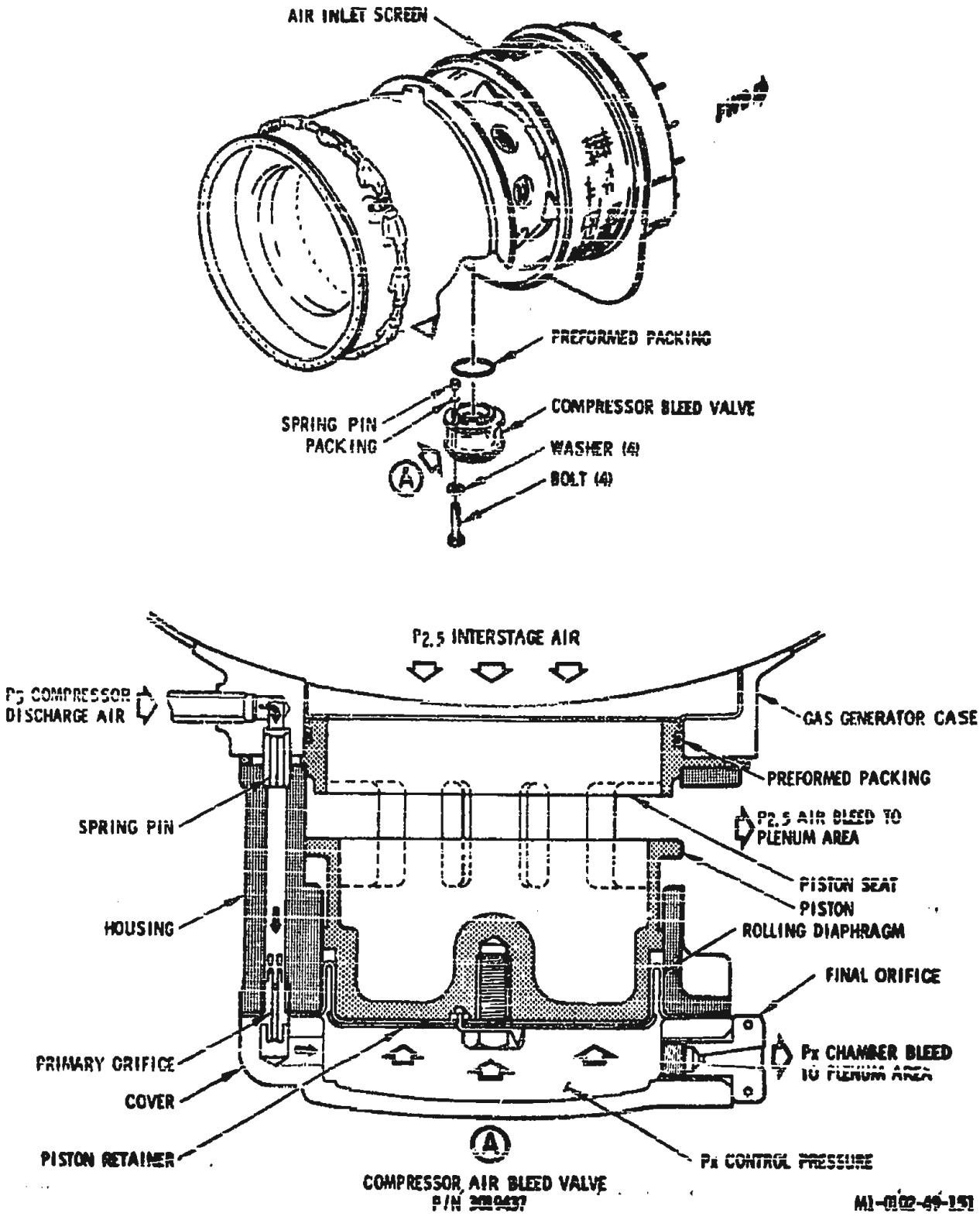
The compressor bleed valve (Ref. Fig. 2) consists of a circular housing and piston. The piston is supported by a rolling diaphragm which permits it to travel in the housing bore. Compressor P2.5 interstage pressure acts against the top of the piston to open the valve. The amount of air bled back to the air inlet plenum is determined by the position of the piston relative to a series of air ports in the housing uncovered by the piston. Compressor discharge pressure (P3) is metered through an orifice (primary orifice) to the bottom of the piston and bled out of the valve through a metering plug (final orifice). The pressure thus established at the bottom of the piston is the valve control pressure (Px) which acts in opposition to the P2.5 pressure to close the valve. As engine gas generator speed increases, P3 pressure, and with it, the Px control pressure rise to a value high enough to overcome the increasing P2.5 pressure and move the piston to a position which closes the valve.

APU's incorporating UACL SB 49-20 have a redesigned compressor bleed valve having a guide-pin supported piston. The valve functions in the same manner as described above. The piston, however, instead of closing off bleed ports in the valve housing, closes off the P2.5 interstage pressure bleed port by making contact with a piston seat surrounding the port. On APU's modified in accordance with HAM STD SB 49-78, and related P&WC bleed valve modification bulletins, the bleed valve primary orifice (P3 air inlet) and final orifice (Px chamber metering plug) are remotely located in a multiple connector mounted on the forward wall of the air inlet plenum. P3 compressor discharge pressure is tapped off the P3 air line to the inlet guide vane system and is routed through a 2-micron P3 air filter to the primary orifice in the multiple connector. Px control pressure developed in the multiple connector is applied to the bleed valve Px chamber through an interconnecting tube.

4. APU Oil System

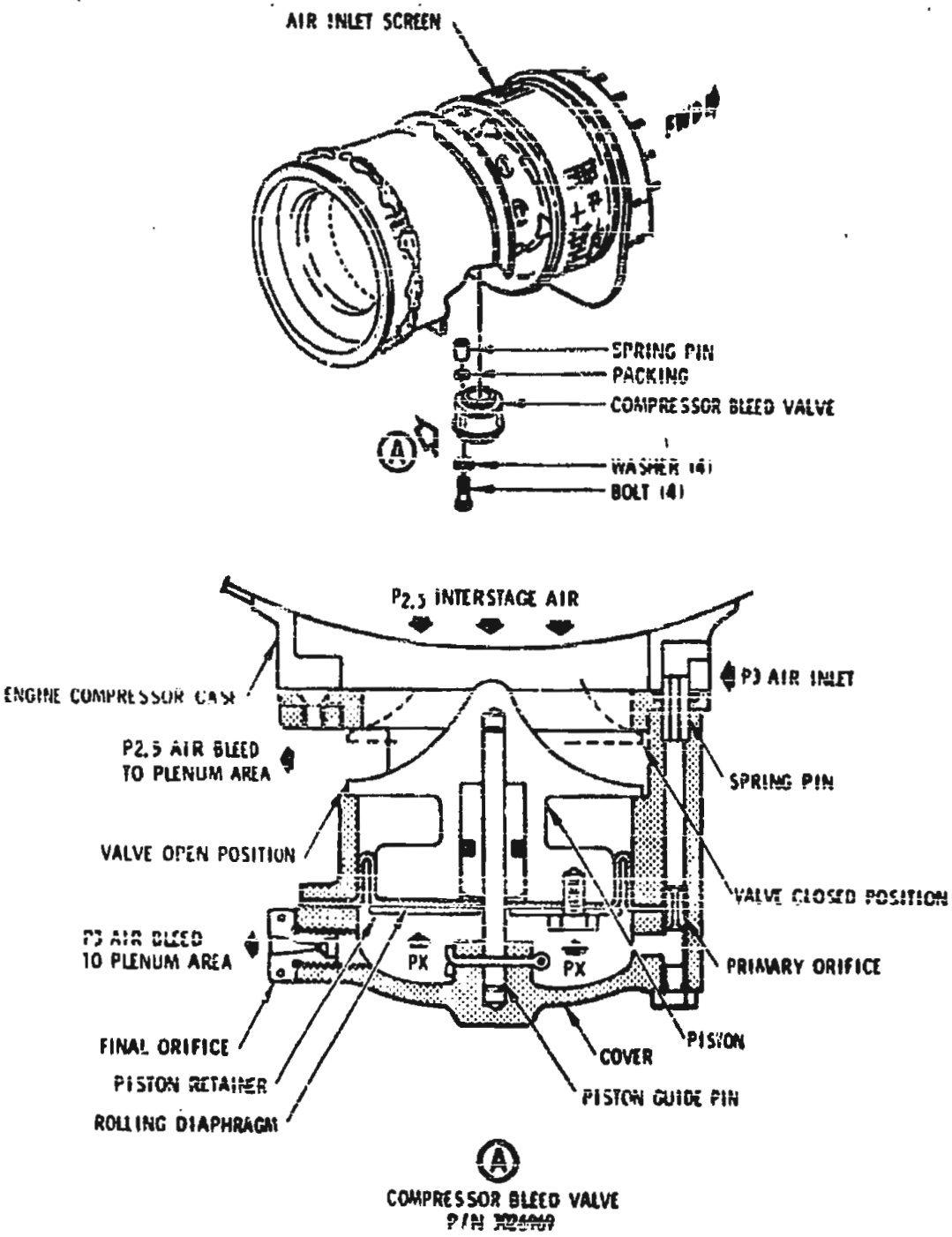
A. Description and Operation

The APU power plant oil system (Ref. Fig. 3) provides a flow of pressurized and filtered lubricating oil to the engine compressor bearings, power section turbine bearings, load hardware gearbox, and accessory drive gearbox. Major elements of the system are an integral oil tank, an oil tank fill housing and oil level sight gage assembly, an oil



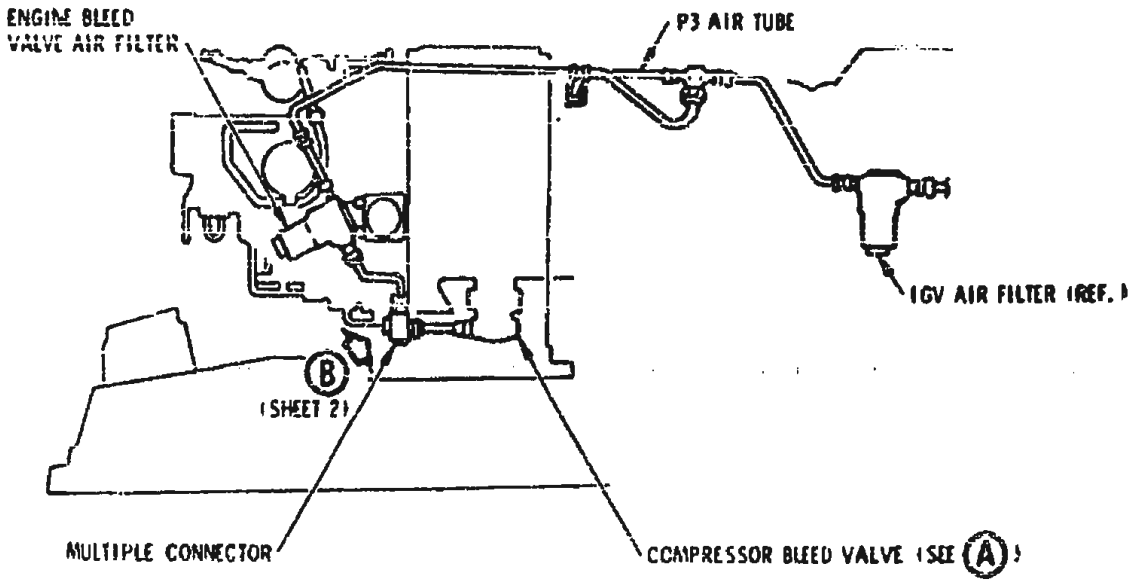
Engine Compressor Air Bleed Valve
Figure 2

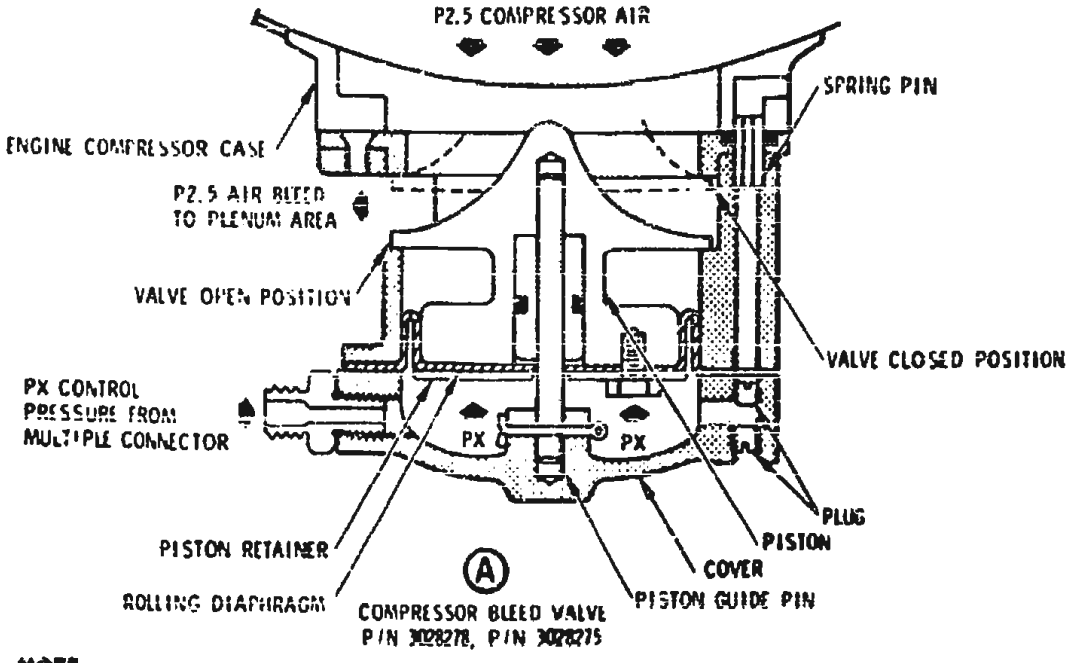
R EFFECTIVITY: APU'S WITHOUT UACL SB49-20 OR
R HAM STD SB49-78
001B



M1-0100-49-592

Engine Compressor Air Bleed Valve
Figure 2





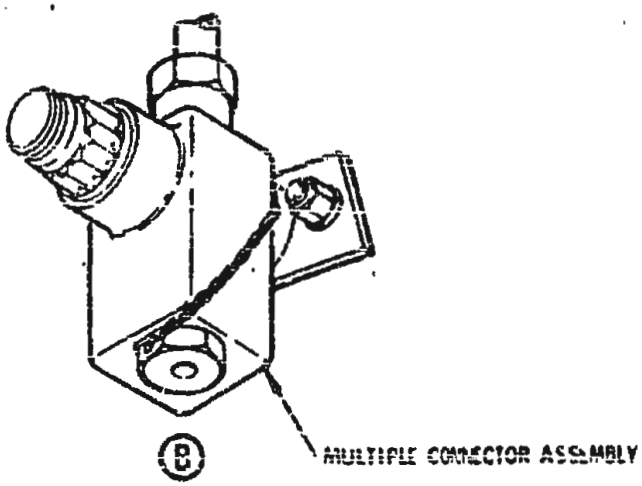
NOTE

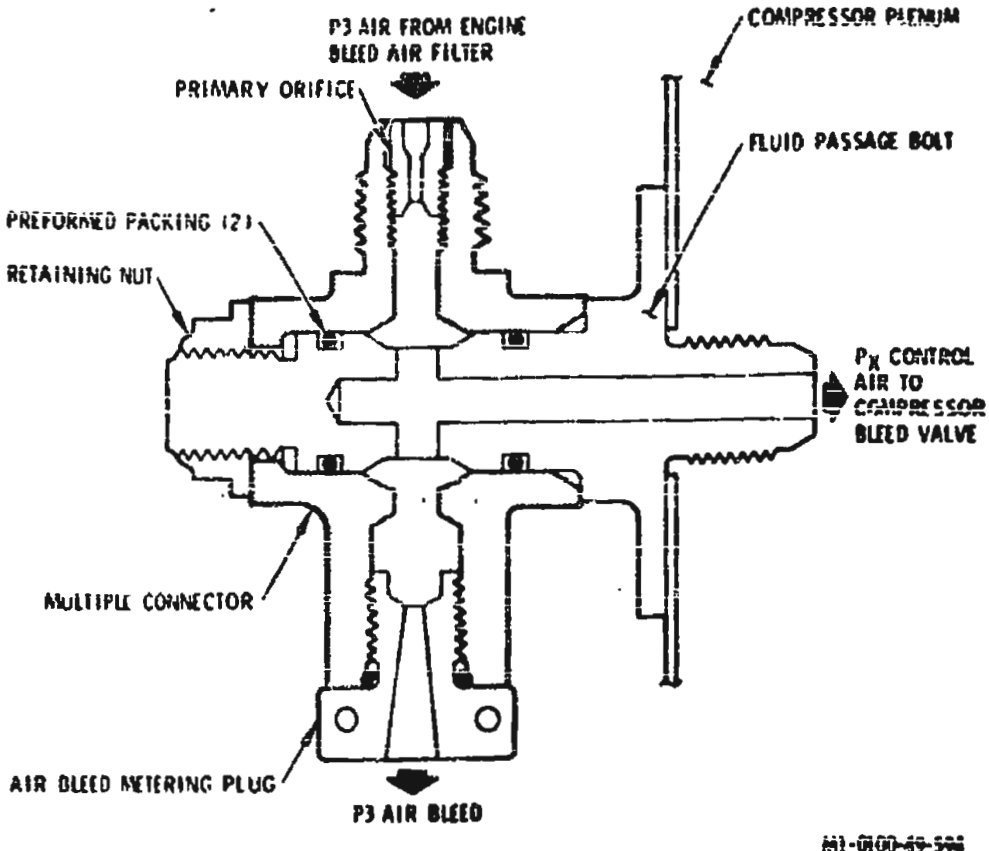
P/N 3028278 IS 3026969 VALVE MODIFIED BY P & WC BULLETIN 3026969-49-1 FOR INSTALLATION ON APU'S WITH REMOTE PRIMARY AND FINAL ORIFICES (REF. P & WC SB 49-47)

P/N 3028275 IS IDENTICAL TO 3028278 EXCEPT FOR IMPROVED PISTON AND RETAINER AND MODIFIED COVER WITHOUT PLUGGED PASSAGES (REF. P & WC SB 49-51)

MI-0100-49-593

Engine Compressor Air Bleed Valve
Figure 2 (Sheet 1)





Engine Compressor Air Bleed Valve
Figure 2 (Sheet 2)

pressure pump, a main oil filter assembly containing inlet check and bypass relief valves, an oil pressure relief valve, two dual element gear-type oil scavenge pumps, and oil-to-fuel heater, and a platform mounted dual oil-to-air heat exchanger (Ref. 49-91-00). One element of the heat exchanger is used to cool scavanged engine and load compressor gearbox oil before it is returned to the oil tank. The other element is used to cool APU generator drive adapter oil which is in a separate self-contained oil system (Ref. 24-14-00). Externally mounted low oil pressure and high oil temperature switches are electrically coupled to the electronic control unit automatic fault shutdown circuitry and the LOW PRESS OIL and HIGH TEMP OIL fault flags on the APU CONTROL panel. A float-type low oil quantity switch is electrically coupled to a LOW OIL QUANTITY advisory light on the APU CONTROL panel. These components are described in Section 49-91-00.

B. Oil Tank

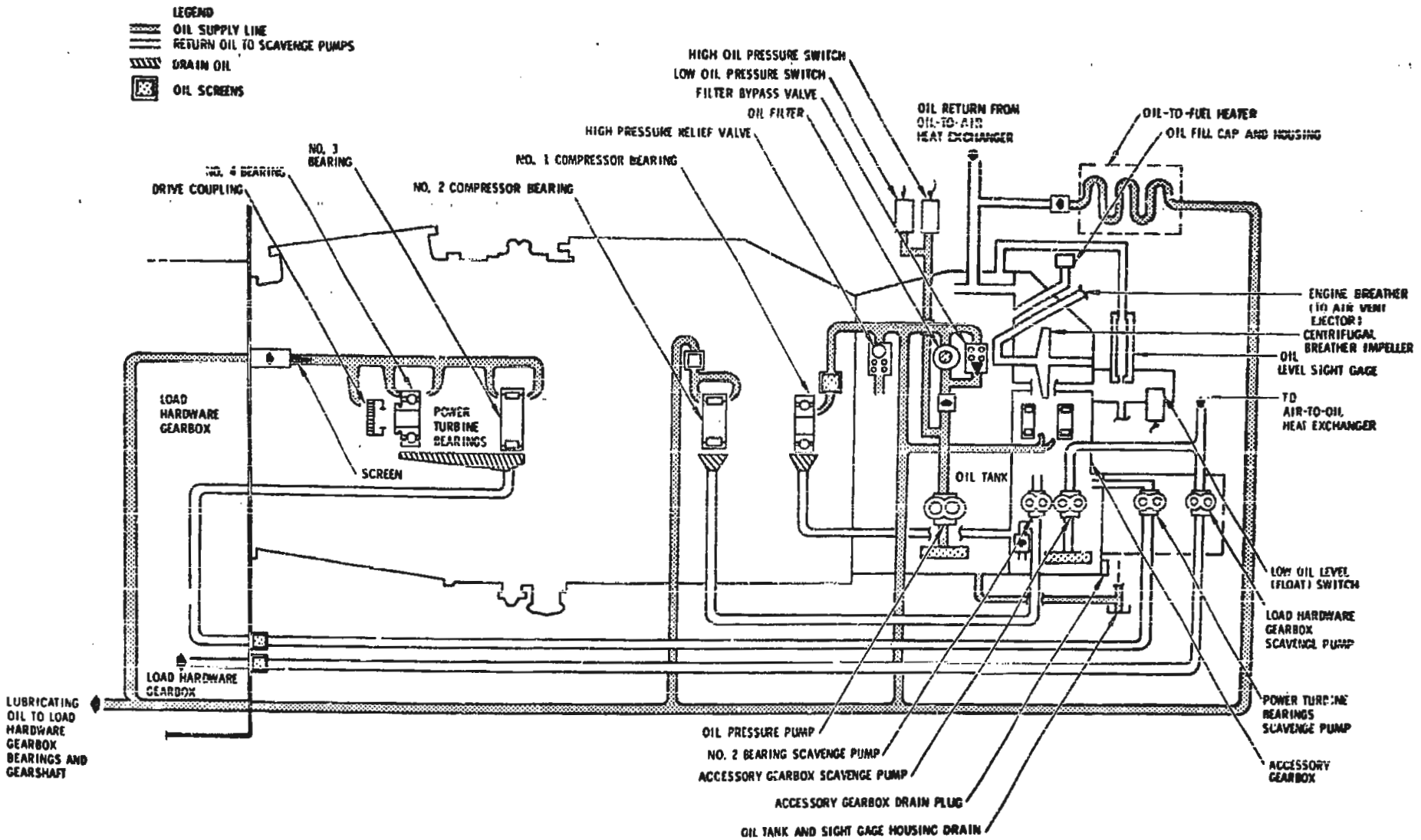
The APU power plant oil supply (Ref. Fig. 1 and 4) is contained in an oil tank located just behind the accessory drive gearbox. The tank is an integral part of the engine compressor case and has a total capacity of 2.3 US gallons of which 2.0 US gallons is usable oil. An oil filler neck at the top of the tank is equipped with a pressure oil fill housing and cap. An oil level sight gage facilitates filling of the tank and checking the quantity of oil in the tank.

C. Oil Pressure Pump

The APU power plant is internally lubricated by an integral gear-type oil pressure pump located in the lowest portion of the oil tank (Ref. Fig. 3). The pump is mounted on the aft side of the accessory gearbox diaphragm and driven by the same gearshaft that drives the accessory gearbox scavenge pump in the gearbox. Oil enters the pump inlet screen and is pumped under pressure through an outlet port that supports the oil inlet end of the main oil filter housing. A spring-loaded check valve in the filter housing prevents backflow of oil from the filter after the APU is shut down and facilitates filter removal without having to drain the oil tank.

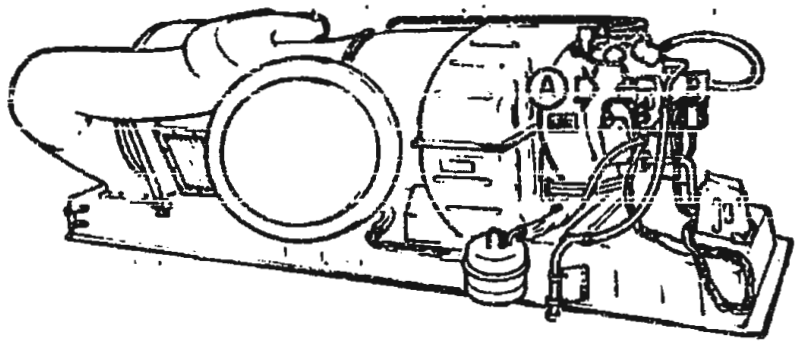
D. Oil Filter Assembly

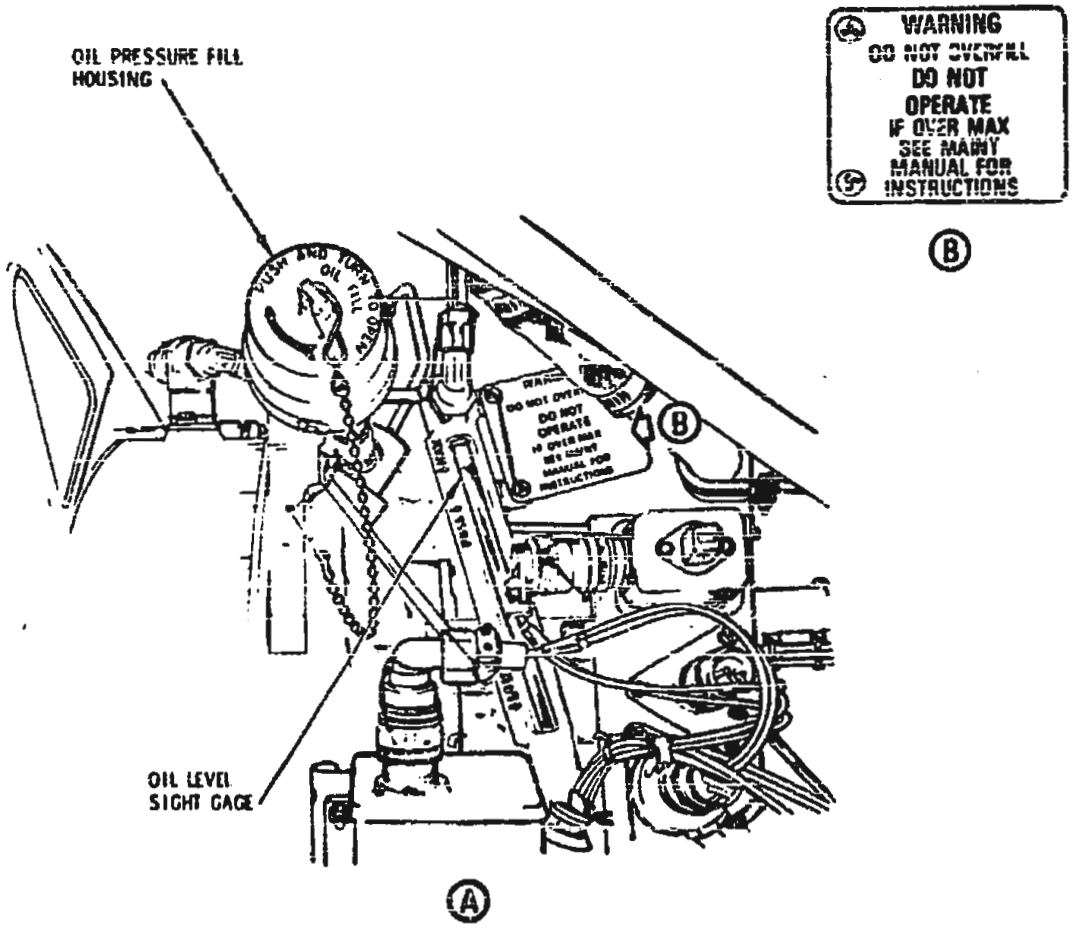
An oil filter assembly containing a cleanable cartridge-type filter element is located on the left side of the accessory gearbox case (Ref. Fig. 5). The element is contained in a housing which is inserted into the gearbox case and supported by the outlet port in the oil pressure pump body.



APU Power Plant Oil System Diagram
Figure 3

R R 0018 EFFECTIVITY: ALL





MI-0100-49-223

Oil Tank Fill Housing and Sight Gage
Figure 4

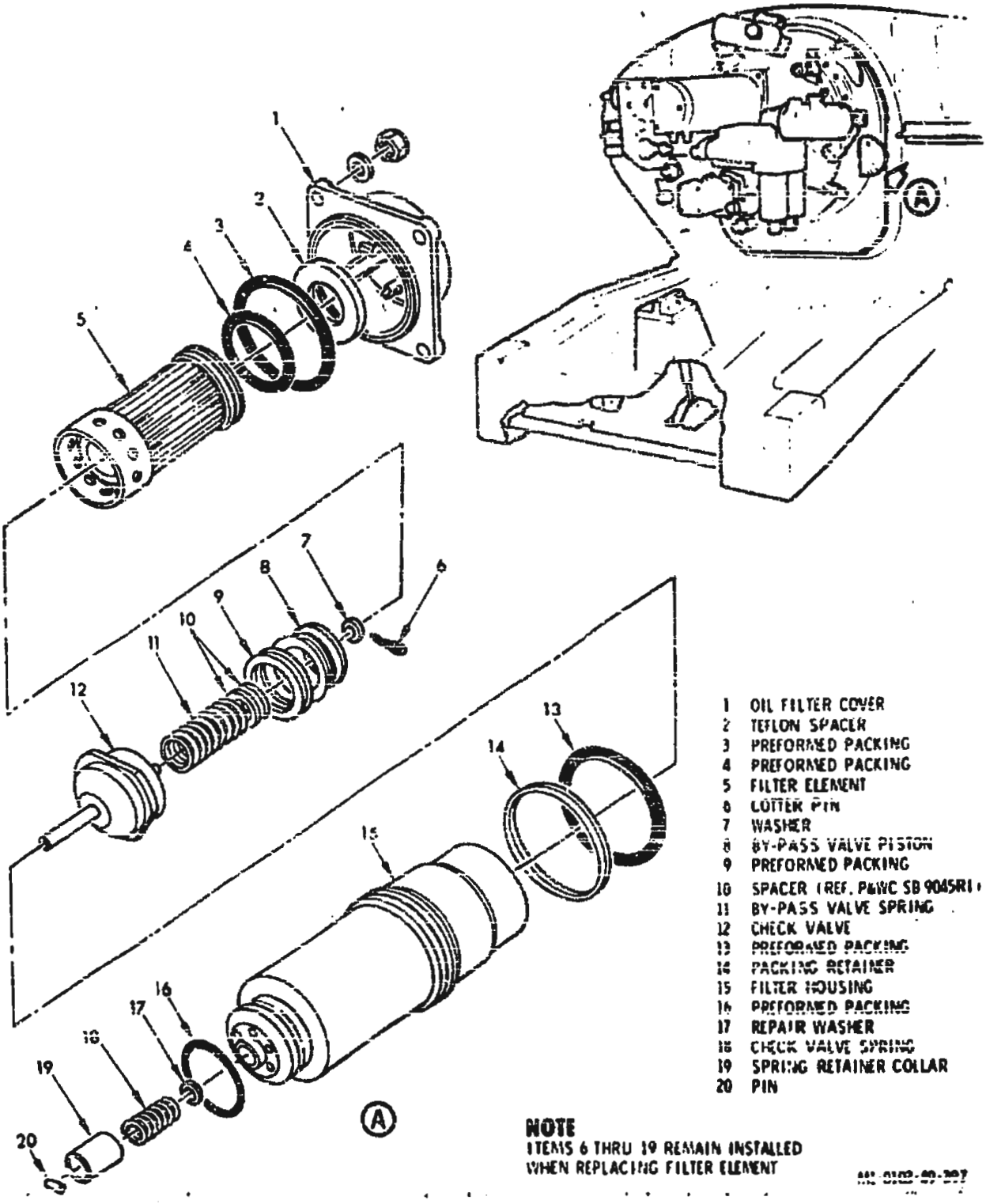
An oil bypass valve and check valve are installed at the inner end of the housing. A filter cover, secured to the gearbox case by four nuts, holds both housing and filter in position. Pressurized oil unseats the check valve and flows through the filter element and filter cap into a cored passage in the gearbox case from where it is distributed to the engine compressor and power section bearings and to the load hardware gearbox. The check valve at the inlet to the oil filter housing prevents backflow of oil from the housing when the APU is shut down. The normally closed oil bypass valve provides an alternate path for unfiltered oil through the core of the element if a clogged element causes sufficient increase in oil inlet pressure to unseat the valve.

E. Oil Pressure Relief Valve

APU power plant lubricating oil pressure is regulated at 80 to 100 psi by a plunger-type pressure relief valve (Ref. Fig. 3) located in the accessory gearbox case just above the oil filter assembly. Oil in excess of the regulated pressure is bypassed back to the oil tank through a cored passage in the gearbox case. Oil pressure is adjusted at the time of engine manufacture/overhaul by the insertion of spacers under the relief valve spring and should require no adjustment while in service.

F. Pressure Oil System Operation

Lubricating oil to the accessory gearbox bearings and drives is supplied through a cored passage and transfer tubes in the gearbox case and diaphragm (Ref. Fig. 3). The forward (No. 1) compressor bearing is lubricated by oil routed through an internal passage in the compressor inlet case to a strainer and oil spray nozzle assembly just behind the bearing. Oil is sprayed by the nozzle into a collector ring and directed through passages in the split inner race to the bearing by centrifugal force. Oil is also directed through a cored passage to an outlet boss at the bottom of the compressor case. From this point, an external tube directs oil to the load hardware gearbox. Oil tapped from this tube is used to lubricate the aft compressor (No. 2) bearing through an internal transfer tube secured to the engine case. The tube passes between two diffuser pipes to an oil gallery from which oil is sprayed through two nozzles onto the No. 2 bearing. A second tube tapped into the load hardware oil supply tube conducts oil through a cored passage in the power section support housing to the two power turbine shaft bearings (No. 3 and No. 4). The cored passage contains a strainer, and a check valve which prevents flooding of the turbine shaft housing during APU start and shutdown. An oil nozzle in the end of the cored



R
R

APU Oil Filter
Figure 5

EFFECTIVITY: ALL

001B

passage lubricates the turbine shaft coupling. An internal oil pressure tube having four oil spray nozzles directs oil from the cored passage onto the No. 3 and No. 4 bearings.

A portion of the oil from the filter outlet is continuously routed through an oil-to-fuel heater to heat the fuel supplied to the APU.

G. Scavenge Oil System Operation

The scavenge oil system (Ref. Fig. 1 and 3) includes two double-element scavenge pumps connected by internal passages and lines to two main external transfer tubes. One pump is secured inside the accessory gearbox and the other is externally mounted. They are contained in separate housings and driven by gearshafts in the accessory gearbox.

Oil from the No. 1 compressor bearing is returned by gravity through an internal cored passage to the bottom of the compressor inlet case where it is conducted across the oil tank through an internal transfer tube and allowed to discharge into the accessory gearbox through a port in the accessory diaphragm.

R No. 2 compressor bearing oil drains into an external tube leading forward to the bottom of the oil tank. Oil is then scavenged through internal transfer tubes in the accessory case diaphragm to the front element of the internal scavenge pump which discharges it into the accessory gearbox.

R Scavenge oil from the two power section bearings collects at the bottom of the power turbine shaft housing and is
R evacuated through internal transfer tubes. The oil is then
R routed through the load hardware gearbox to an external scavenge tube. The external scavenge tube carries oil forward to the front element of the external scavenge pump which discharges it, through machined passages in the pump housing, into the accessory gearbox.

Load hardware gearbox oil is scavenged, through an external transfer tube, by the forward element of the external scavenge pump and discharged into the oil tank through an external oil-to-air heat exchanger.

R Accessory gearbox oil is scavenged by the rear element of
R the internal scavenge pump which discharges it through a
R T-fitting into the outlet line from the forward element of
R the pump. Oil is returned to the oil tank through the oil-to-air heat exchanger.

5. Engine Breather System

A. Description and Operation

Bearing sealing air is returned with scavenged oil to the accessory gearbox and vented overboard through a centrifugal breather mounted on the starter drive gearshaft. Sealing air from the No. 1 compressor bearing is vented forward through the bearing forward housing and the oil tank center tube, into the accessory gearbox. Sealing air from No. 2 compressor and power section turbine bearings is returned to the accessory gearbox entrained in the scavenge oil. A relief valve in the No. 2 bearing oil scavenge line to the scavenge pump permits the line to breathe freely with the engine running at high power. Air entrained in the load
R hardware gearbox scavenge oil separates in the oil tank and
R is vented into the accessory gearbox through a breather pipe at the top of the oil tank. The accessory gearbox is vented to atmosphere through an overboard vent tube routed to a fitting in the upper surface of the APU compartment air vent ejector.

B. Centrifugal Breather

A centrifugal breather consisting of a shrouded aluminum alloy impeller is installed in the upper portion of the accessory gearbox and driven by the APU starter drive gearshaft (Ref. Fig. 1). The impeller separates oil from the air-oil vapors in the gearbox. Breather air flows through the impeller where oil particles are separated from the vapor by centrifugal force. The oil particles are thrown outward and drain to the bottom of the accessory gearbox. The relatively oil-free breather air passes aft through the hollow section of the impeller driveshaft to a cored passage in the accessory case diaphragm to a breather outlet fitting on the accessory gearbox. The breather outlet fitting is exposed to the atmosphere through an overboard breather vent tube (Ref. Para. A).

6. Oil-to-Fuel Heater

A. Description and Operation

The oil-to-fuel heater (Ref. Fig. 5) is basically a thermostatically controlled heat exchanger in which engine oil heat is used to preheat fuel admitted to the APU fuel pump. The unit contains a fuel temperature sensing Vernatherm element which, when heated, exerts an expansive force against a spring-loaded slide valve. The position attained by the slide valve determines the amount of oil that is allowed to circulate through the heater core. Oil

not flowing through the core is bypassed to the oil outlet port. Since the Vernatherm element exerts an expansive force only, it is contracted by the spring-loaded slide valve when fuel temperature is decreased. At fuel outlet temperatures of 70 degrees F (21 degrees C), the bypass valve begins to open and oil flow through the core is decreased. At 90 degrees F (32 degrees C), the oil port to the core is closed and all of the oil flow is bypassed to the heater outlet port.

7. Oil Drains

A. Description

The provisions listed below are provided for draining oil from the APU power plant (Ref. Fig. 7).

(1) A capped line is located just below the externally mounted oil scavenge pump. Removal of the cap will allow oil to drain from the oil tank and the oil level sight gage housing.

(2) The accessory gearbox case is drained by removing a drain plug located in the lower part of the case just below the Ng speed sensing tachmometer.

(3) Oil in the load hardware gearbox is drained by removing a drain plug in the lower part of the gearbox. The plug is equipped with a magnetic chip detector. Any accumulation of ferrous particles on the detector should be analyzed for an indication of possible excessive wear or impending failure of an internal component before the plug is reinstalled.

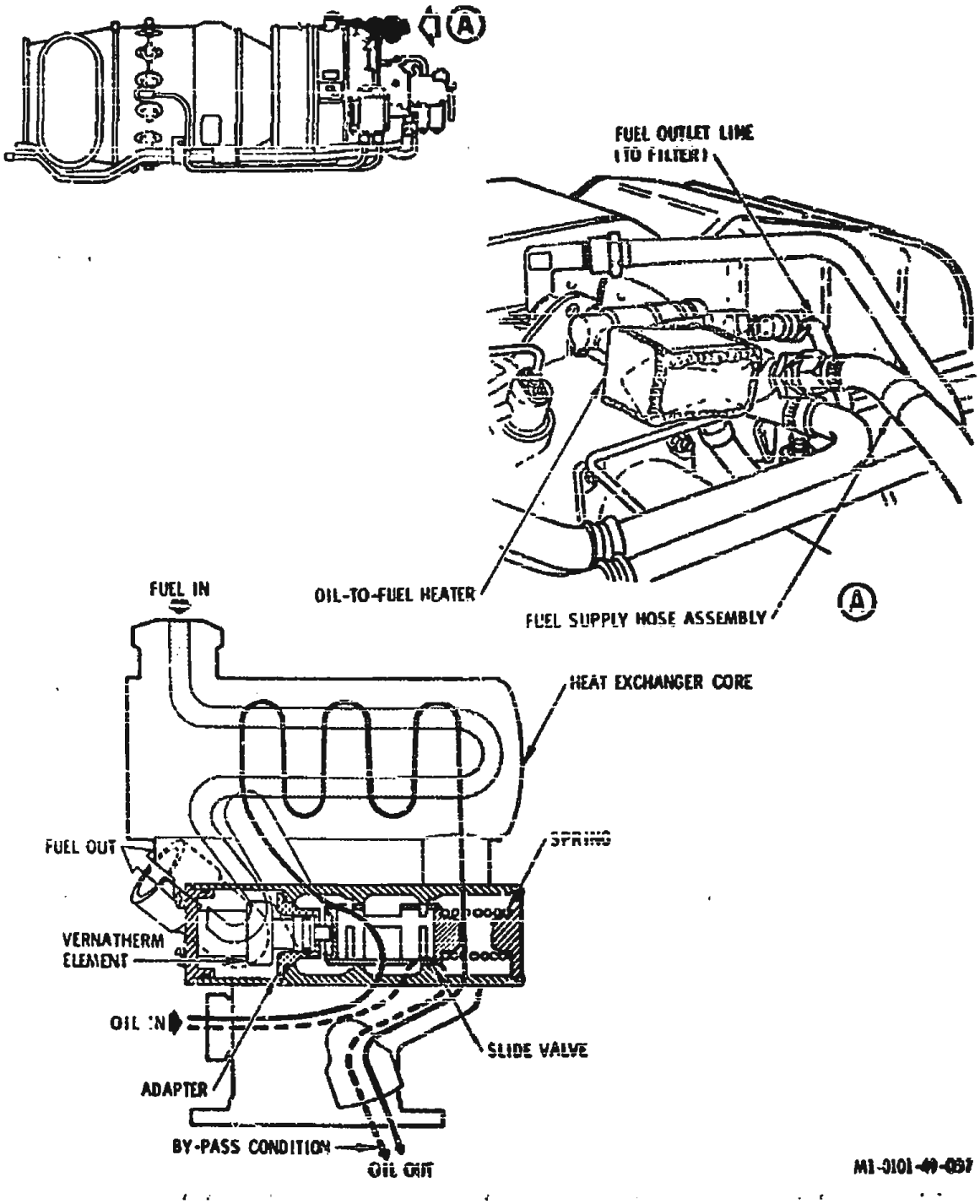
(4) R Oil drained from the APU starter mounting and fuel pump drive pads is collected in the APU drip tank and may be R drained by removing a drain plug on the lower part of the tank.

(5) The APU starter clutch housing (on APU's equipped with a clutch) has a supply of lubricating oil in the clutch housing. This oil is drained by removing a hex head plug at the bottom of the housing (Ref. 49-41-04).

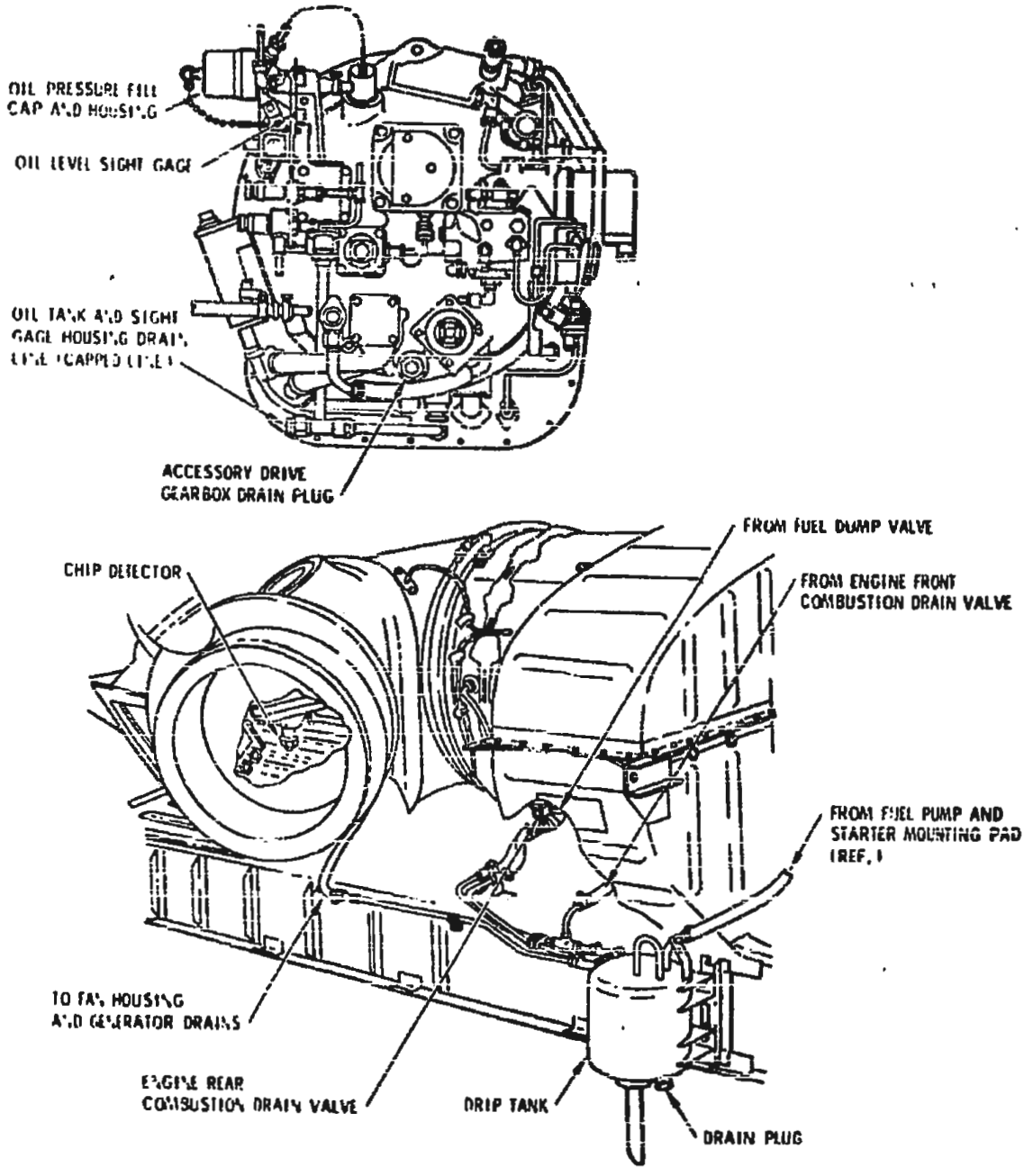
8. System Operation

A. Engine Operation

Air enters the engine compressor through a screened oval plenum chamber from the APU mounting platform and is



Oil-to-Fuel Heater
Figure 6


OIL PRESSURE FILL CAP AND HOUSING
OIL LEVEL SIGHT GAGE
OIL TANK AND SIGHT GAGE HOUSING DRAIN LINE (CAPPED END)
ACCESSORY DRIVE GEARBOX DRAIN PLUG
FROM FUEL DUMP VALVE
CHIP DETECTOR
FROM ENGINE FRONT COMBUSTION DRAIN VALVE
FROM FUEL PUMP AND STARTER MOUNTING PAD (REF.)
TO FAN HOUSING AND GENERATOR DRAINS
ENGINE REAR COMBUSTION DRAIN VALVE
DRIP TANK
DRAIN PLUG
MI-0100-49-219

APU Oil Drain Provisions
Figure 7

compressed by three axial compressor stages and a single stage centrifugal compressor (Ref. Fig. 1). Stator vanes located between each stage of compression diffuse the air, increases its static pressure, and directs it to the next higher stage of compression. From the centrifugal compressor stage, the compressed air passes through diffuser pipes which change the air flow direction 90 degrees through straightening vanes into the annular area surrounding the combustion chamber. Air enters the combusition chamber through varying sized perforations in the annular wall of the chamber where the flow is reversed 90 degrees. At this point fuel is injected into the chamber through 14 fuel injection nozzles. During an APU start the combustible air/fuel mixture is ignited by two spark igniters. Once ignition occurs, the igniters are switched off and combustion is self-sustaining. The expanding hot gasses reverse direction 90 degrees, and flow through the engine turbine guide vanes which direct the flow in the proper angle required to rotate the engine turbine with minimum loss of energy. The still expanding hot gasses continue through a second set of guide vanes to drive the free turbine. Power extracted from the energy in the hot gasses is used by the turbines in driving the engine compressor and the load hardware gearbox. After passing through both turbines, the hot gasses are directed to the atmosphere through the engine exhaust duct which receives a cooling air flow from the load compressor driven cooling fan.

B. Engine Power Control

Engine power output is controlled by a free turbine speed controller on the engine accessory gearbox. The unit is not driven by the gearbox, but merely installed in a convienient location on the gearbox provided for its support.

R Electrical signals from the electronic control unit (ECU)
R positions a torque motor operated valve in the free turbine
R speed controller. The valve position will increase or
R decrease Py air pressure in the fuel control unit (FCU)
R which will result in an increase or decrease of fuel flow to
R the engine combustion chamber (Ref. 49-31-00).

An Ng tachometer, mounted on and driven by the accessory gearbox, transmits to the ECU a signal reflecting the rotational speed of the engine gas generator section. This signal is processed by the ECU engine speed/load control circuits to derive the engine power control output signal applied to the free turbine speed controller (Ref. 49-61-00).

APU GAS TURBINE ENGINE - MAINTENANCE PRACTICES

1. General

An APU engine compressor wash is periodically performed to dislodge foreign deposits which collect on the surfaces of the engine compressor and deteriorate APU performance. Two methods for performing this task are currently being used, depending on the availability of approved wash solution.

Method I (Ref. Step 4A) injects a wash solution into the compressor air inlet plenum while the APU is motored through a dry cycle (ignition and fuel off). The solution is allowed to soak for approximately 15 minutes. The procedure is then repeated a second time. The APU is then dry motored while water is injected to rinse out the wash solution. After sufficient time for engine starter cooling, the APU is operated to dry out the engine.

Method II (Ref. Step 4B) injects a wash solution into the compressor air inlet plenum with the engine operating at idle rpm. The solution is carried through the engine where it acts to dislodge the various deposits collected on the compressor blades. As the bond between the deposits and coated surface is broken, the deposits are ejected with the engine exhaust gases as a fine powder. A water rinse cycle, as used in Method I, is not required.

A. Performance Comparison

It is recommended that performance be checked before and after wash to determine its effectiveness. Operating conditions must be similar to permit accurate analysis:
R e.g., 1 air conditioning pack, 40KW, MAX MODE, using number 2 duct pressure indication. After operation has stabilized, record Ng, TGT, duct pressure, OAT, and barometric pressure.

2. Equipment and Materials

Aviation Kerosene or Jet Fuel (Ref. Para. 3)

APU Engine Wash Rig, Locally Fabricated (Ref. Fig. 201)

Compressed Air Source, Nitrogen or clean filtered Shop Air, capable of pressurizing the wash rig tanks at a regulated pressure of 20 to 30 psig

Methanol (AMS 3004), (Procured Locally)

Potable Water (Method I)

Demineralized Water (Method II)

Wash Solution (Ref. Step 3)

CR Wash Solution - TWA Stk Nbr 50-1180

CR Preferred: Rochem GTE Compressor Cleaner, Rochem Ltd,
CR Suite 304, 11 Broadway, N.Y., N.Y. 10024 or Marind
CR Inc., P.O. Box 3402, Manhatten Beach, Calif. 90266

CR Alternate: Revenaes RMC

CR Distilled Water - TWA Stk Nbr 50-0521 or local source.

Lock-wire, Fed Spec QQ-W-390 0.032-inch diameter, or equivalent

3. Preparation of Wash Solution

CR A. Method I - DELETED

A. Method II

(1) To prepare the wash solution using Rochem GTE or RMC, mix in accordance with the following table:

	Product	Temperature (degrees F)	Mixture % by Volume: Cleaning Agent	Demineralized Water	Methanol (AMS3004)
R R	RMC	+36 and above (+2°C and above)	100	0	0
R R	RMC	below +36 (below 2°C)	40	0	60
R R	Rochem	+36 and above (+2°C and above)	33.3	66.7	0
	Rochem	below +36 (below 2°C)	33.3	26.7	40

Product	Temperature (degrees F)	Mixture % by Volume: Cleaning Agent	Demineralized Water	Methanol (AMS3004)

NOTE: Criteria for demineralized water are as follows:

Appearance: Free of suspended solids

Total Solids: 10 parts per million maximum

Specific Conductance: 11 micromhos/cm maximum

Silica Content: 3 ppm maximum

pH Value: 5.0 to 7.0 inclusive

Intake filter no coarser than 10 microns

NOTE: Wash fluid will drop out of solution if pre-mixed and allowed to set. Thoroughly agitate wash solution prior to injection into engine.

4. APU Engine Wash

C A. DELETED

A. Wash Procedure (Method II)

NOTE: Two washes (minimum) of approximately .53 gallons (2 litres) each are recommended.

(1) Open left and right forward APU access doors.

(2) Remove the APU wash fitting cap (Ref. Fig. 202) and connect the wash rig hose.

C (3) Service the wash rig cleaning soltuion tank with Rochem
C GTE Compressor cleaner TWA Stk Nbr 50-1180 mixed two
C parts distilled water TWA Stk Nbr 50-0521 to one part
C Rochem. Verify that wash tank shutoff valves (Ref.
C Fig. 201) are closed.

C NOTE: Assure that the wash rig has sufficient fluid,
C at least one gallon of the Rochem and Distilled
CR water mixture.

C (4) Pressurize the cleaning solution tank to a regulated
C output of 25 to 30 psig.

NOTE: Pressure should be adjusted and/or properly sized orifice installed to obtain 2 liter flow in about 30 seconds. Pressure required depends on orifice size (if used), line size and length, and vertical distance of APU above wash rig.

NOTE: Actual tank outlet pressure coincident with a full open tank shutoff valve should be experimentally determined and thereafter set at a pressure that will force a minimum of one gallon of cleaning solution into the compressor plenum during the time that the engine is at idle rpm.

(5) Operate APU in MIN MODE for a minimum time of two minutes with No. 2 ECS pack on and normal electrical load to stabilize engine temperatures. (Performing the wash on a thoroughly warmed up engine helps the RMC solution break down the bond between the deposits and metallic surfaces in the engine.)This is an appropriate time to accomplish the performance comparison, Paragraph 1A.

NOTE: If AC power is required for other aircraft systems during the wash period, apply external electrical power.

CR (6) Depress the APU STOP switch. As engine RPM drops off, CR open the wash tank shutoff valve and allow the solution CR to flow into the engine. Engine will decelerate to CR idle for 80 seconds before shutting down.

CR NOTE: Injection of wash solution into the engine will CR result in a TGT drop of 50 to 100 degrees. If CR the drop in TGT is not noted, the wash procedure CR should be terminated and the wash rig CR investigated for possible low air pressure, low CR fluid level, or blockage in the fluid supply CR line (including blockage of the spray ring in CR the compressor plenum).

CR (7) While APU is at idle, open wash rig shutoff valve. CR After 30 seconds press the APU START button to restore CR APU to normal.

CR CAUTION: CLOSE WASH RIG SHUTOFF VALVE IF ENGINE DECELERATES CR BELOW IDLE.

CR (8) Close wash rig shutoff valve as APU is returned to CR normal speed.

CR (9) Repeat Steps (5), (6), (7), and (8).

C (10) Run APU in MIN MODE for 5 minutes with one pack
C operating to stabilize temperatures.

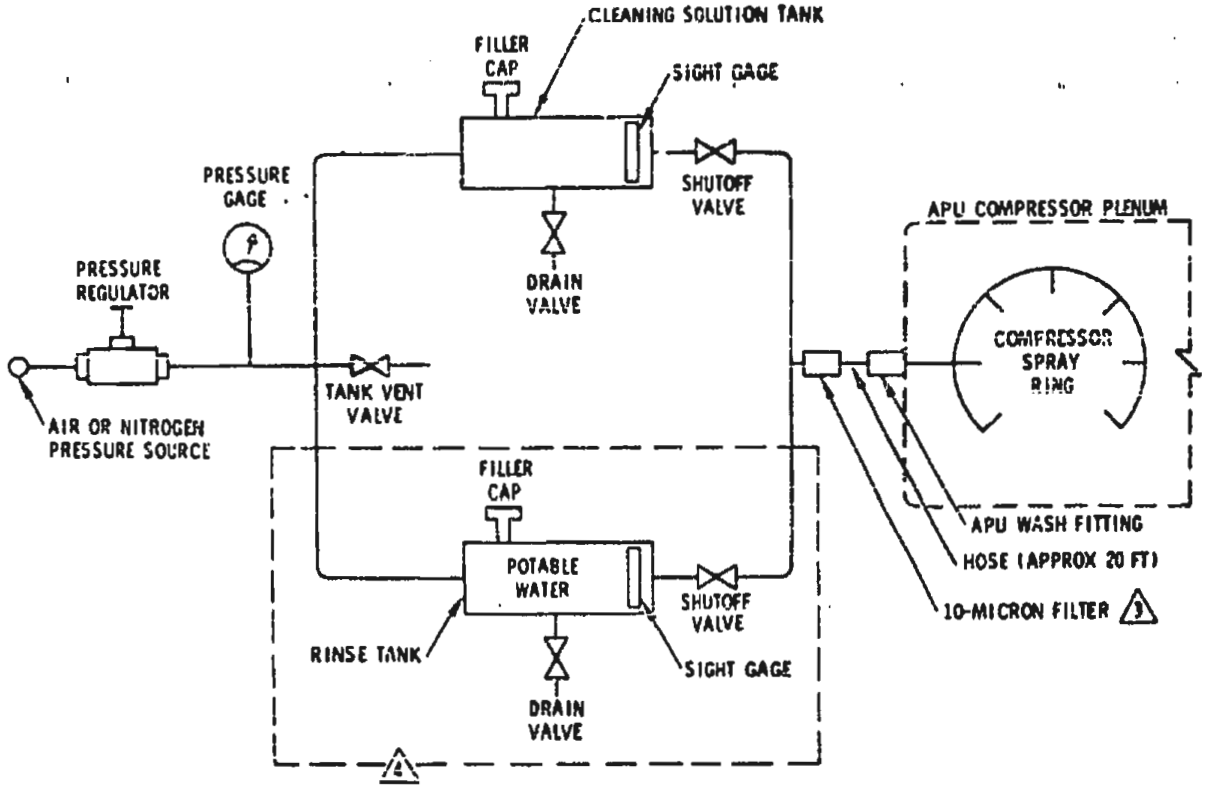
(11) Shut down APU.

(12) Depressurize wash rig and disconnect wash rig hose. Reinstall wash fitting cap.

(13) Record engine ETI reading and record in aircraft maintenance log.

(14) Close APU access doors making certain that fluid drain catcher is positioned aft against platform scupper.

R NOTE: Comparison of pre- and post-wash Ng, TGT, and duct pressure parameters may not show an immediate improvement. The benefits of the wash will be noticed during the operating periods following the wash as a gradual increase in APU performance.



NOTE

1. CLEANING SOLUTION AND WATER CONTAINERS ARE MINIMUM 5 GALLON CAPACITY STAINLESS STEEL UNITS. EACH CONTAINER MUST BE PLACARDED WITH APPROPRIATE CONTENT LABEL
2. CONTAINER PRESSURIZATION PLUMBING MUST BE 5/16-INCH MINIMUM DIAMETER
3. REMOVE WHEN USING WASH RIG WITH RIVENAES MOTOR CLEANER AND COMPRESSOR WASH PROCEDURE, METHOD II
4. THIS PORTION OF RIG NOT REQUIRED FOR METHOD II.

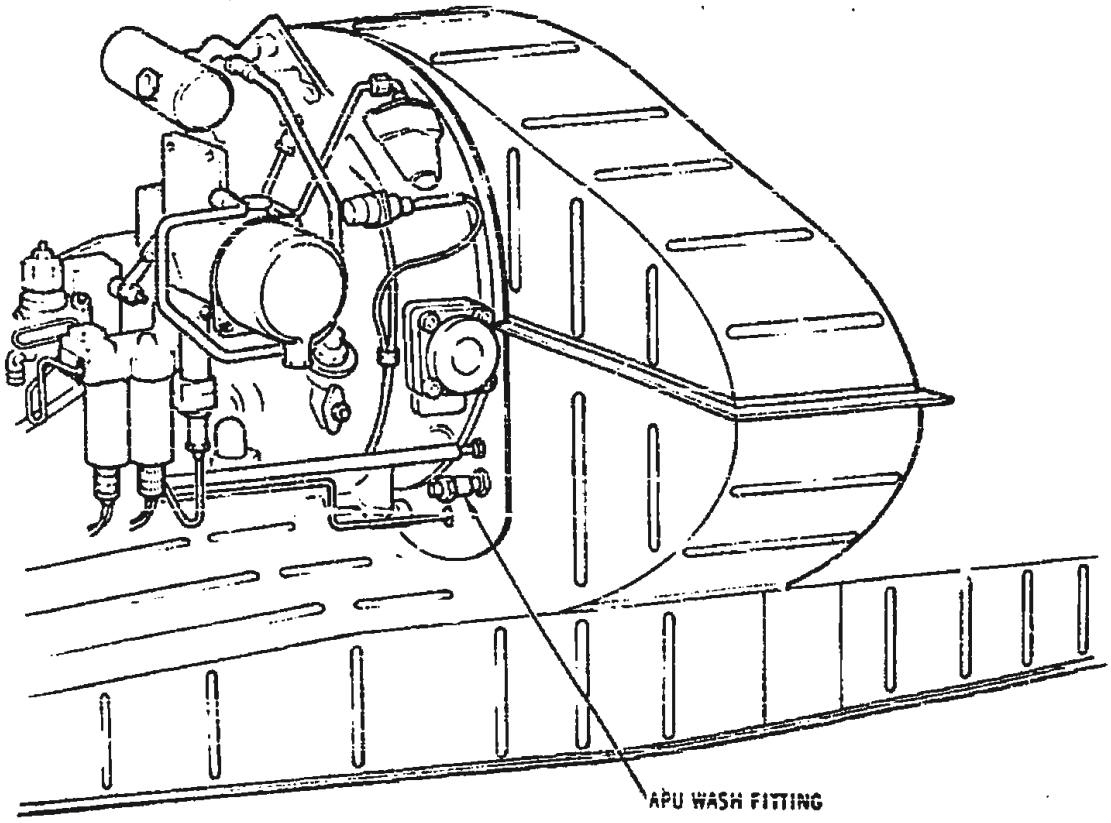
M1-0104-49-194

CR
CR

APU Engine Wash Rig Diagram
Figure 201

EFFECTIVITY: ALL

0018



MI-0100-49-205

CR
CR

APU Engine Wash Fitting
Figure 202

R
R
0019

EFFECTIVITY: ALL

APU GAS TURBINE ENGINE - SERVICING

1. Equipment and Materials

Containers (2), 1 and 5 gallon

Oil Cooler Drain Pan, locally fabricated

Desiccant (with Humidity Indicators)

Flushing Fixture, APU Oil Cooler, GS 15103-1, or equivalent (locally fabricated (Ref. Fig. 302)

Gasket, Oil Cooler Thermostat, Ham Std P/N 8A27-000, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.032-in. diameter, or equivalent

Lubricating Oil (Ref. Table 301)

Oil Servicing Cart, Model 550LPT (modified), Loe Industries or equivalent

Plug, Fuel Inlet Hose, HAM STD GS 14485-16, or equivalent

Preformed Packing, Drip Tank and Accessory Gearbox Drain Plugs (Ref. Fig. 301)

Preformed Packing, Chip Detector (Ref. Fig. 301)

Preservative Oil, MIL-O-6081 (Grade 1010), or equivalent

R Preservative Oil Jig

Troughs (Locally fabricated as required to direct drained oil into containers)

2. Referenced Procedures

12-12-41	Auxiliary Power Unit - Oil Replenishing
24-41-00	External Power/Ground Service System - Maintenance Practices
49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test
49-21-04	Oil Filter Element - Removal and Installation
49-51-23	Chip Detector - Removal and Installation

3. Servicing

A. General

A capped oil pressure fill port and oil quantity sight gage are located at the upper right part of the APU accessory drive gearbox (Ref. Fig. 501).

Drain plugs are provided for draining the accessory drive gearbox and the drip tank. The load hardware gearbox is drained by removing the chip detector plug located at the bottom of the gearbox housing. A capped fitting is located just below the accessory drive gearbox scavange oil pump at the termination of a piping installation connected to the oil tank and oil level sight gage housing. Removing the cap will drain both oil tank and sight gage.

B. Oil Quantity Check and Replenishment

NOTE: Check oil tank level 5 to 30 minutes after the APU is shutdown. Observe warning placard attached to the sight gage.

(1) Open the forward right APU access door, being sure to open catcher assembly on inlet scupper first.

(2) Observe oil level sight gage. When oil level is between FULL and LOW, the quantity required for replenishment to the full level is determined as follows:

Oil Level Distance From the FULL mark	Oil Level (U.S. Quarts/Liters Low)
1.0 in. (2.54 cm)	1 qt (0.9l)
1.5 in. (3.8 cm)	2 qts (1.8l)
2.5 in. (6.3 cm)	3 qts (2.8l)
3.5 in. (8.9 cm)	4 qts (3.7l)

R CAUTION: OILS LISTED IN TABLE 301 ARE THE ONLY OILS THAT HAVE BEEN APPROVED FOR USE IN THE APU. OILS OF DIFFERENT BRANDS OR TYPES MUST NOT BE MIXED AS THEY MAY BE INCOMPATIBLE. SHOULD DIFFERENT BRANDS OR TYPES BECOME MIXED OR IF THE APU IS TO OPERATE WITH A DIFFERENT OIL THAN THAT CURRENTLY BEING USED, THE OIL SYSTEM MUST BE FLUSHED IN ACCORDANCE WITH THE PROCEDURE IN PARAGRAPH 3G AND THE SYSTEM SERVICED WITH THE APPROVED OIL SPECIFIED IN AUXILIARY POWER UNIT - OIL REPLENISHING (REF. 12-12-41).

Approved APU Lubricating Oils
Table 301

	TYPE I OIL	TYPE II OIL
	BP Aero Turbine Oil 15	BP Enerjet 51
R	Exxon (Esso) Turbo Oil 2389	Castrol 5000
R	Mobil Avrex S Turbo 256	Exxon (Esso) Turbo Oil 2380
R	Stauffer Jet 1	Mobil Jet Oil II
R		Mobil RM 254
R		Stauffer Jet II
R		Aero Shell Turbine Oil 500
R		Aero Shell Turbine Oil 555 (1)

NOTE: EXXON Turbo Oil 2389 and EXXON Turbo Oil 2380 may be designated as ESSO or ENCO Turbo Oil depending on the marketing area in which this product is procured.

R (1) Provided P&WC SB49-1 has been incorporated.

(3) Remove oil pressure fill housing cap.

(4) Attach oil servicing cart hose to pressure fill housing.

(5) Replenish oil tank with required amount of oil using oil specified in 12-12-41).

(6) Remove hose and reinstall pressure fill housing cap.

C. Starter Clutch Oil Quantity Check and Replenishment

(1) Open forward left APU Compartment access door.

(2) Release spring clip retainer from oil quantity indicator and extract indicator from clutch housing. Read oil quantity level on indicator markings (Ref. Fig. 301).

(3) If oil quantity is low, replenish to full mark by pouring oil through indicator bushing. Use same oil type specified for APU engine.

NOTE: Clutch oil level on an installed APU should be 1/16 to 1/8 inch above the hole in the indicator dipstick.

(4) Reinstall oil quantity indicator and snap spring clip into slot at top of indicator.

D. Oil Drain - Oil Tank

(1) Place a locally fabricated metal trough under the oil tank and sight gage housing drain fitting (Ref. Fig. 301). The trough should be formed so that it will direct drained oil into a container at the side of the APU platform. Approximately 2 gallons of oil will be drained from a full oil tank.

(2) Remove the nut and cap from oil drain fitting and allow oil to drain into the container.

(3) Reassemble nut and cap and reinstall on drain line fitting. Tighten cap to a torque of 450-500 lb in. and install 0.032-inch diameter lock-wire.

E. Oil Drain - Load Hardware Gearbox

NOTE: The load hardware gearbox is drained by removing the chip detector (Ref. 49-51-23).

(1) Place a locally fabricated metal trough under the chip detector (Ref. Fig. 301). The trough should be placed so that it will direct drained oil into a container at the side of the APU platform.

(2) Remove chip detector and allow oil to drain into container.

(3) Install new preformed packing on chip detector. Install chip detector and tighten to a torque of 25 (±5) lb in. Install 0.032-inch diameter lock-wire.

F. Oil Drain - Accessory Drive Gearbox

(1) Place suitable pan under the accessory gearbox drain plug (Ref. Fig. 301).

(2) Loosen drain plug sufficiently to allow oil to drain from gearbox.

(3) Install new preformed packing on drain plug. Install drain plug and tighten to a torque of 215-240 lb in. Install 0.032-inch diameter lock-wire.

G. Oil Drain - Drip Tank

(1) Hold suitable container under drip tank (Ref. Fig. 301).

(2) Remove drain plug and allow all fluid to drain from tank.

(3) Install new preformed packing on drain plug.

(4) Reinstall drain plug. Tighten plug and install 0.032-inch diameter lock-wire.

H. Oil Drain - Starter Clutch

(1) Fabricate a sheet metal drain trough which, when placed under the starter clutch, will direct drained oil into a container. The container must be sized to hold at least 4 oz. of APU engine oil.

(2) Remove clutch oil quantity indicator (Ref. Fig. 301).

(3) Loosen drain plug at bottom of clutch housing.

(4) Place drain trough under clutch, remove drain plug, and drain oil into container.

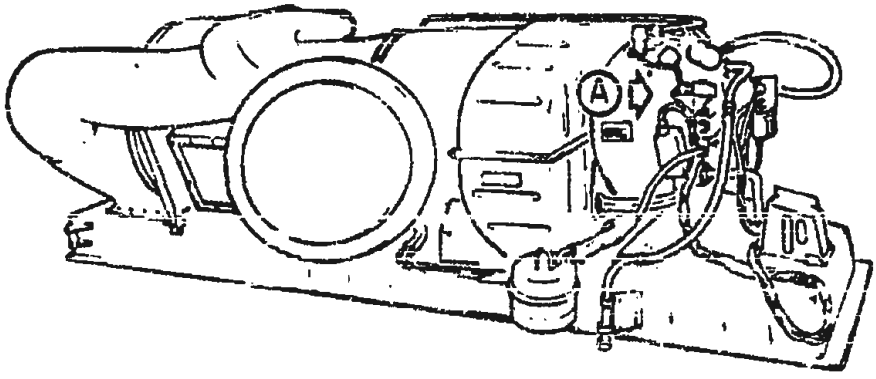
(5) Reinstall drain plug. Tighten plug and lockwire plug to drilled head screw located near drain plug.

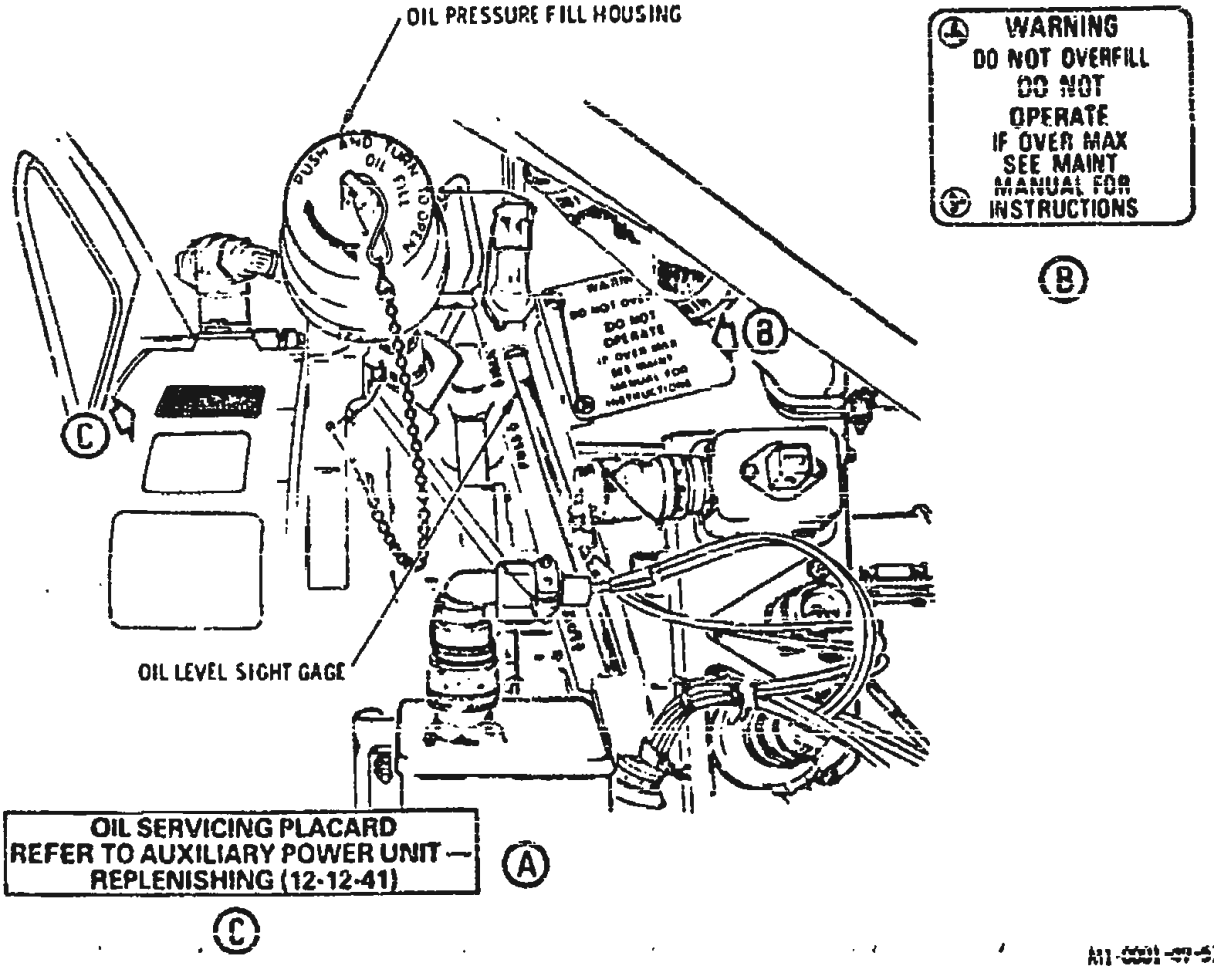
(6) Fill clutch with 4 oz. of the same oil as specified for the APU engine through the oil quantity indicator bushing.

(7) Install oil quantity indicator.

NOTE: Be certain oil quantity indicator spring clip retainer is securely engaged in the indicator slot.

I. Oil System Flushing

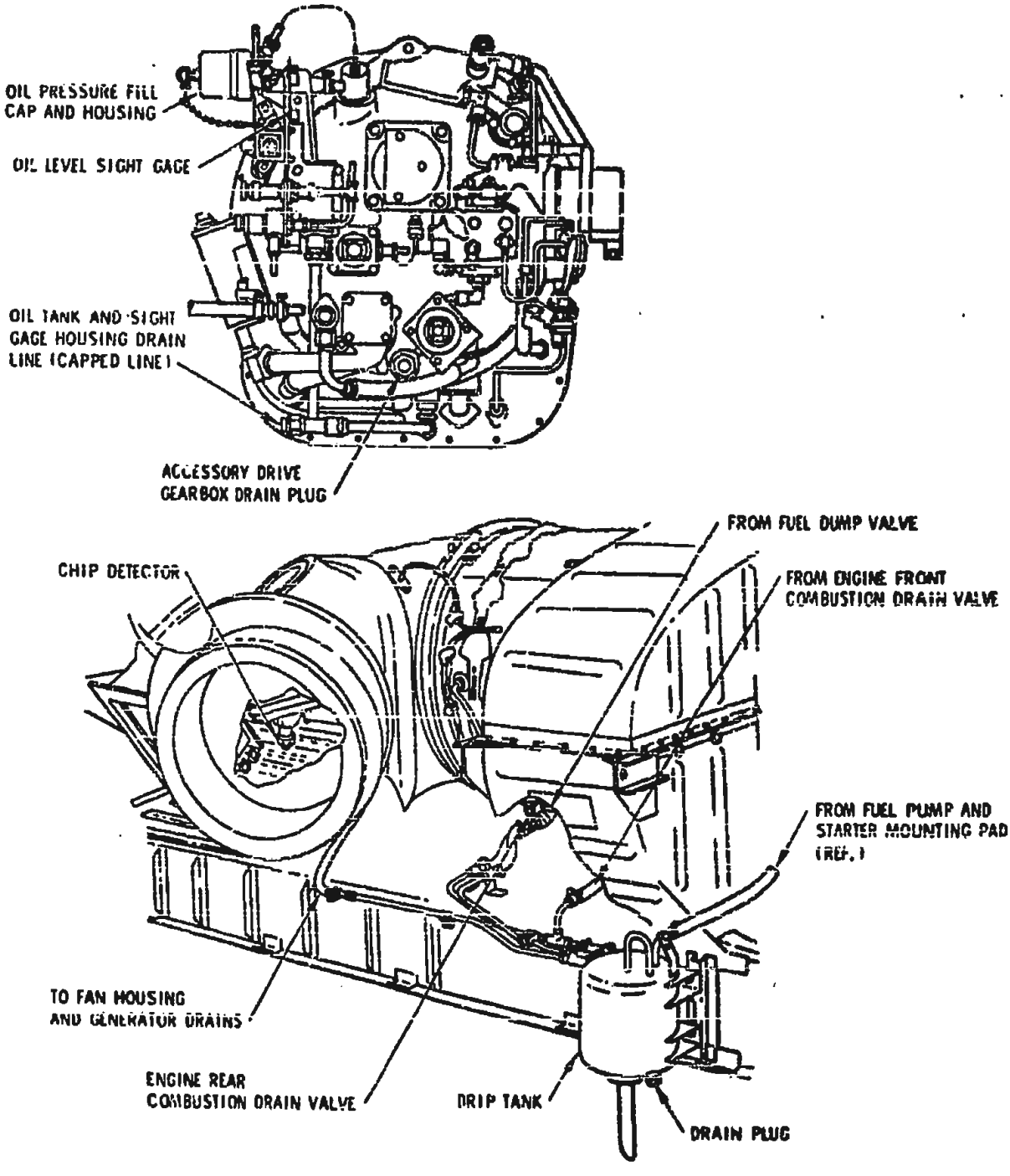




R APU Oil System Drain and Refill Provisions
R Figure 301 (Sheet 1)

EFFECTIVITY: ALL

0018

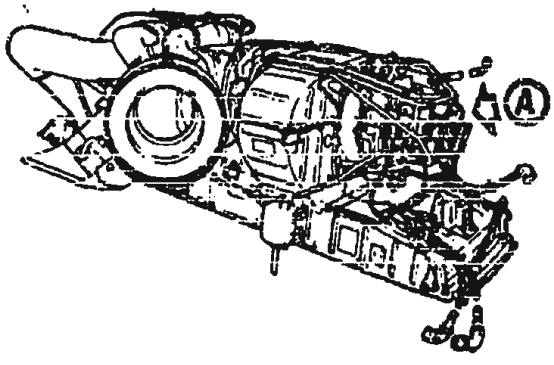

OIL PRESSURE FILL CAP AND HOUSING
OIL LEVEL SIGHT GAGE
OIL TANK AND SIGHT GAGE HOUSING DRAIN LINE (CAPPED LINE)
ACCESSORY DRIVE GEARBOX DRAIN PLUG
FROM FUEL DUMP VALVE
CHIP DETECTOR
FROM ENGINE FRONT COMBUSTION DRAIN VALVE
FROM FUEL PUMP AND STARTER MOUNTING PAD (REF.)
TO FAN HOUSING AND GENERATOR DRAINS
ENGINE REAR COMBUSTION DRAIN VALVE
DRIP TANK
DRAIN PLUG
M1-0100-49-219

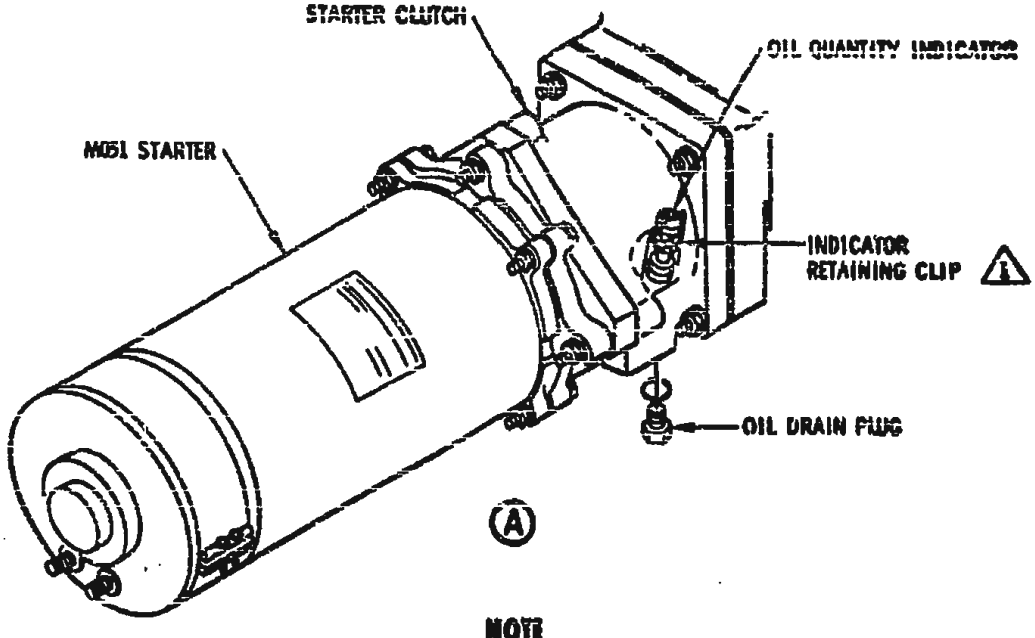
R
R

APU Oil System Drain and Refill Provisions
Figure 301 (Sheet 2)

EFFECTIVITY: ALL

001B





NOTE
1 REPLENISH CLUTCH OIL SUPPLY THROUGH OIL QUANTITY INDICATOR BUSHING

M1-0100-49-003

R
R

APU Oil System Drain and Refill Provisions
Figure 301 (Sheet 3)

EFFECTIVITY: ALL

001B

(1) Manually close the APU primary and secondary emergency fuel shutoff valves.

(2) Deactivate the APU ignition system by manually tripping
R the APU IGNITION RCCB located in the AEEA, zone 164.

(3) On the Flight Engineer/Second Officers aft circuit breaker panel CB5, open and tag circuit breakers APU IGNITION (S11), and FIREWALL SHUTOFF - SEC (S8).

(4) Drain oil from oil tank, load hardware gearbox, and accessory drive gearbox (Ref. Paragraphs 3D, 3E, and 3F). Do not reinstall drain plugs or caps at this time. Do not remove drain troughs and containers.

(5) Position a drain pan (having a drain trough or line routed to the side of the APU platform) in the area directly under the forward oil cooler (engine oil) thermostat. Remove the thermostat and drain the oil cooler. Install GS15103-1 flushing fixture (Ref. Fig. 302).

(6) Turn on external electrical power (Ref. 24-41-00).

(7) Dry cycle engine (Ref. 49-00-01) to permit scavenge oil pumps to clear the engine of oil. To prevent excessive rotation of engine with limited lubrication, depress APU STOP switch to terminate starter operation the moment oil ceases to flow in a steady stream from the oil drain openings.

(8) Remove GS 15103-1 flushing fixture and temporarily reinstall the oil cooler thermostat, oil tank drain fitting cap, and drain plugs.

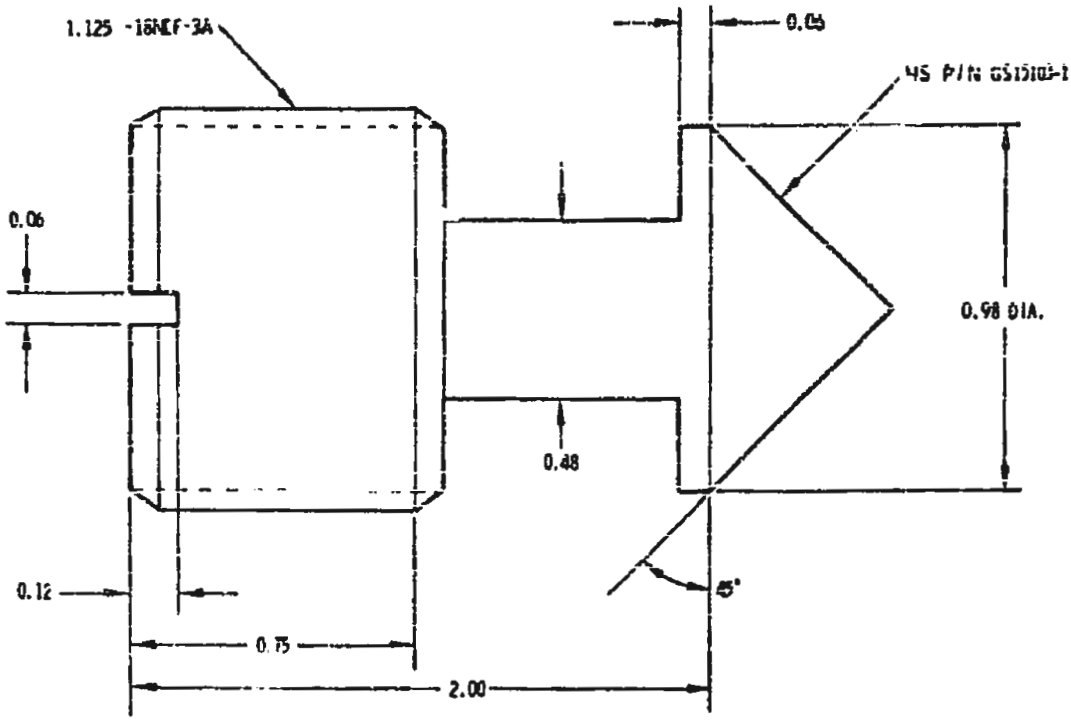
(9) Fill the oil tank to specified level with approved lubricating oil (Ref. 12-12-41).

(10) Manually open the APU primary and secondary emergency fuel shutoff valves and reset the APU IGNITION RCCB.

(11) Remove tags and close circuit breakers opened in Step 3.

(12) Operate APU for approximately 5 minutes (Ref. 49-00-01).

(13) When APU has cooled sufficiently, remove the forward oil cooler thermostat, oil tank drain fitting cap, accessory drive gearbox drain plug and load hardware gearbox chip detector to drain all oil from the APU.



MATERIAL: RECOMMEND BRASS
TOLERANCE: ±0.02 IN.

M1-0100-49-461

APU Oil Cooler Flushing Fixture
Figure 302

(14) Reinstall oil cooler thermostat using new gasket (Ham Std P/N 8A271-000 or equivalent). Tighten thermostat to a torque of 400 lb in. Install lock-wire.

(15) Install accessory drive gearbox drain plug and chip detector. Tighten drain plug to a torque of 215-240 lb in. and chip detector to torque of 20-30 lb in. Install lock-wire.

(16) Install oil tank drain fitting cap. Tighten cap to a torque of 450-500 lb in. and install lock-wire.

(17) Remove and clean the engine main oil filter. Reinstall filter. (Ref. 49-21-04).

(18) Fill the oil tank to specified level with approved oil (Ref. 12-12-41).

(19) Operate APU for approximately 2 minutes. Check for oil leaks.

(20) Check oil level and replenish as necessary.

(21) Turn off external electrical power (Ref. 24-41-00).

4. Preservation

A. General

The following schedule lists the requirements for preserving installed engines which are to be inactive for various periods of time.

(1) 7 Days

(a) Installed engines may be inactive up to 7 days without preservation provided the aircraft is in an area that does not subject the engine to extreme environmental changes and excessive humidity.

CR (2) 8 to 90 days

CR (a) Installed engines that will be inactive up to 90
CR days require no preservation provided all engine
CR openings are sealed and the engine is not subject
CR to a corrosive atmosphere.

CR (b) Make entry in aircraft records that APU
CR preservation was accomplished for maximum of 90
CR day storage. (3) 91 Days or More. (a)

CR Installed engines that will be inactive more than
CR 90 days must not be subject to a corrosive
CR atmosphere and must have the engine oil and fuel
CR system preserved. (Ref. Paragraph 4 B & C) in
CR addition to sealing all engine openings.

B. Engine Fuel System Preservation

(1) Manually close the APU primary and secondary emergency fuel shutoff valves.

(2) Deactivate the APU ignition system by manually tripping the APU IGNITION RCCB located in the AESC, zone 164.

(3) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, open and tag circuit breakers APU IGNITION (S11), and FIREWALL SHUTOFF - SEC (S8).

CAUTION: TO MINIMIZE ENTRY OF FOREIGN MATERIAL INTO THE APU FUEL SYSTEM, THE PRESERVATIVE OIL SUPPLY EQUIPMENT MUST BE EQUIPPED WITH SUITABLE FILTERS OR STRAINERS NO COARSER THAN 10 MICRON RATING.

(4) Disconnect fuel line at outlet port of APU automatic fuel shutoff valve and allow fuel to drain into suitable container. Plug disconnected fuel line. Connect a locally fabricated drain line to the outlet port fitting and route the other (open) end into a container large enough to contain the preservative oil that will be flowed through the fuel system.

(5) Disconnect and cap the APU fuel supply line at the oil-to-fuel heater.

CR (6) Connect preservative oil supply hose to the oil-to-fuel
CR heater fuel inlet fitting. Apply preservative oil Stk.
CR Nbr 50-0842 at a pressure of 5 to 25 psi and a minimum
CR temperature of 16 degrees C (60 degrees F).

(7) Apply external electrical power (Ref. 24-41-00).

(8) Turn on APU MASTER POWER switch and depress START switch to motor APU through one dry cycle (Ref. 49-00-01). Verify that preservative oil flows out of automatic fuel shutoff valve into container.

CR (9) Disconnect preservative oil drain hose and connect fuel
CR line at valve outlet fitting.

CR (10) Disconnect preservative oil supply hose and connect
CR fuel line at oil-to-fuel heater fuel inlet fitting.
CR (11) Perform applicable 8 to 90 days or longer

CR preservation tasks specified in Paragraph 4A. Install
CR caps, plugs, or covers over all engine air inlet and
CR outlet openings.

C. Engine Oil System Preservation

(1) Preserve engine fuel system in accordance with Paragraph 4B, Steps (1) through (10).

(2) Drain oil from oil tank, load hardware gearbox, and accessory drive gearbox (Ref. Paragraphs 3D, 3E, and 3F). Do not reinstall drain plugs or caps at this time. Do not remove drain troughs and containers.

CR (3) Remove main oil filter (Ref. 49-21-04) and drain oil
CR from filter cavity.

CR (4) Allow engine to set until oil draining from the
CR openings has slowed to a slow occasional drip.

CR (5) Reinstall main oil filter (Ref. 49-21-04).

CR (6) Remove oil drain troughs and containers.

CR (7) Install accessory drive gearbox drain plug and chip
CR detector. Tighten drain plug to a torque of 215-240 lb
CR in. and chip detector to a torque of 20-30 lb in.
CR Install lock-wire. Service oil tank with clean engine
CR oil.

CR (8) Install oil tank drain fitting cap. Tighten cap to
CR torque of 450-500 lb in. and install lock-wire.

CR (9) Install plugs, cover plates, or tape over all engine
CR air inlet openings.

CR (10) Install tag on oil tank cap showing date of
CR preservation.

5. Depreservation

CR A. Procedure for engines stored up to 7 days

CR (1) No action required

CR B. Procedure for engines stored 8 to 90 days

CR (1) Remove all caps, plugs and covers from APU

CR (2) Make entry in aircraft records that all caps, plugs and
CR covers removed.

CR C. Procedure for engines stored over 90 days.

CR NOTE: Other than assuring the engine oil tank is serviced
CR with approved type oil, the oil system does not
CR require any special depreservation procedure.

CR (1) Remove all engine air inlet and outlet covers installed
CR when unit was preserved. (2) Service engine oil tank with approved lubricating oil (Ref. 12-12-41.

(3) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, remove tag and close circuit breaker FIREWALL SHUTOFF - SEC (S8). Verify that circuit breaker APU IGNITION (S11) is open and tagged.

(4) Manually open the APU primary and secondary emergency fuel shutoff valves.

CR (5) Remove plug installed in bottom of combusion drain can.

CR (6) Apply external electrical power (Ref. 24-41-00).

CR (7) Displace preservative oil in engine fuel system by dry
CR cycling the engine (Ref. 49-00-01) until clean fuel
CR flows out of the automatic fuel shutoff valve into the
CR container.

CR CAUTION: OBSERVE STARTER OPERATING LIMITATIONS (REF.
CR 49-00-01).

CR (8) Install drain plug in combustion drain can.

CR (9) Check security and safety of all connections.

CR (10) Remove tag and close APU IGNITION circuit breaker
CR (CB3-S11).

CR (11) Operate APU and check for fuel and oil leaks.

CR (12) Shut down APU and check oil tank level.

CR (13) Record in aircraft records that APU fuel and oil system
CR was depreserved per maintenance manual.

OIL FILTER ELEMENT - REMOVAL AND INSTALLATION

1. Equipment and Materials

R Pre-formed packing (Ref. Fig. 401)Puller, CPWA 30556, or
R equivalent

2. Referenced Procedures

49-21-04 Oil Filter Element - Inspection and Check

49-21-04 Oil Filter Element - Cleaning and Painting

3. Removal/Installation

A. Removal

R (1) Gain access to APU engine oil filter by opening APU
R access door 319AL.

R (2) Remove filter cover and teflon spacer at 3 o'clock
R position of compressor inlet case. Retain teflon
R spacer with cover. Discard preformed packing (Ref.
R Fig. 401).

R (3) Remove filter element from filter housing using puller
R CPWA 30556, or equivalent tool. Remove and discard
R preformed packing on filter element.

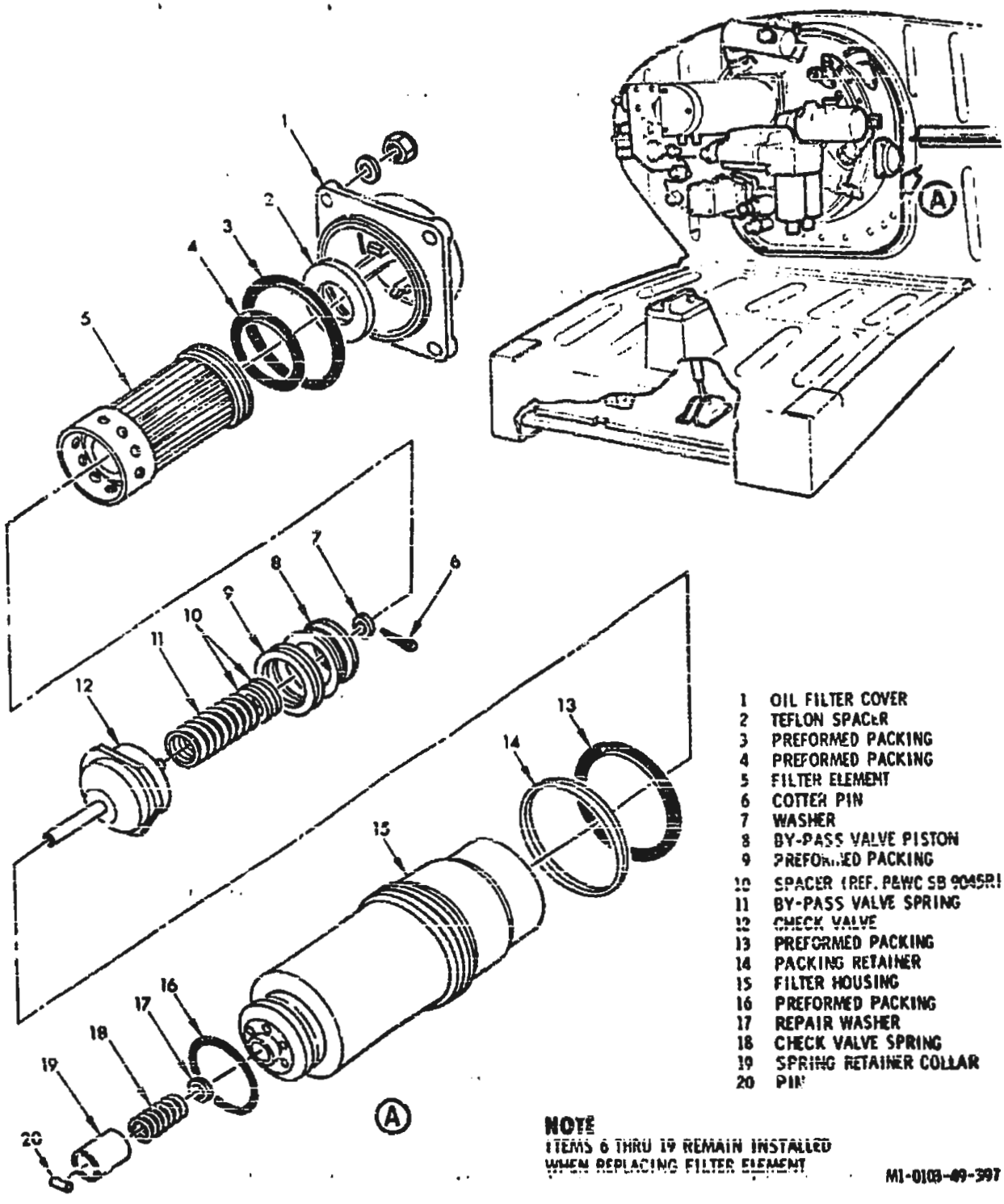
R NOTE: Inspect and clean filter element (Ref. 49-21-04,
R Cleaning and Painting), or replace element.

B. Installation

(1) Install new pre-formed packing in the outer groove of the filter element and insert the filter element (perforated end first) into the filter housing. Do not install pre-formed packing in the internal groove (the requirement for a seal at this location has been deleted).

(2) Install new pre-formed packing on the filter cover. Check that the Teflon spacer is in the proper position on the lugs of the cover.

(3) Install the filter cover and secure with washers and nuts. Tighten nuts to a torque of 20 to 30 lb in.



1 OIL FILTER COVER
2 TEFLON SPACER
3 PREFORMED PACKING
4 PREFORMED PACKING
5 FILTER ELEMENT
6 COTTER PIN
7 WASHER
8 BY-PASS VALVE PISTON
9 PREFORMED PACKING
10 SPACER (REF. P&WC SB 9045R1)
11 BY-PASS VALVE SPRING
12 CHECK VALVE
13 PREFORMED PACKING
14 PACKING RETAINER
15 FILTER HOUSING
16 PREFORMED PACKING
17 REPAIR WASHER
18 CHECK VALVE SPRING
19 SPRING RETAINER COLLAR
20 PIN

NOTE
ITEMS 6 THRU 19 REMAIN INSTALLED WHEN REPLACING FILTER ELEMENT

M1-0103-49-397

R R APU Oil Filter - Removal and Installation
Figure 401

EFFECTIVITY: ALL

R (4) Operate APU and check for oil leak at filter cover.

R (5) Close and latch APU compartment access door.

OIL FILTER ELEMENT - INSPECTION AND CHECK

1. Equipment and Materials

Strong magnifying glass (10 power, minimum)

2. Referenced Procedures

49-21-01	Airborne Auxiliary Power Unit (APU) - Servicing
49-21-04	Oil Filter Element - Removal and installation
49-21-04	Oil Filter Element - Cleaning and Painting

3. Inspection/Check

Perform the oil filter element maintenance actions listed in Table 601 in accordance with airline time limits and maintenance standards.

Inspection and Check Maintenance Actions
Table 601

MAINTENANCE ACTION	REFERENCE
A. Remove Oil Filter Element	
(1) Remove the oil filter element.	49-21-04,401
B. Inspect Oil Filter Element	
(1) Allow the excess oil to drain from the filter element and visually inspect the element, then take the following action as applicable:	
(a) If the filter is contaminated with nonmagnetic sludge or coke, clean element and reinstall. Check condition of engine oil and change or replenish as necessary.	49-21-01
(b) If the filter shows bright metal deposits, check the magnetic sump plugs. If the magnetic plugs also show bright metal, replace the APU.	

Inspection and Check Maintenance Actions (Cont)
Table 601

MAINTENANCE ACTION	REFERENCE
(c) If the filter shows nonmagnetic bright metal chunks, in contrast to flakes or slivers caused by normal wear, replace the APU.	
(d) If the filter shows nonmagnetic bright metal flakes or slivers, clean or replace the filter, change engine oil, and recheck after the APU has been operated for 1 to 4 hours. If more flakes or slivers are found replace the APU.	49-21-01
(2) Clean the filter element and inspect with a strong magnifying glass to check for proper cleaning. If more than 5 percent of the visible passages are blocked, the filter element must be replaced and sent to an overhaul facility for cleaning with ultrasonic equipment.	49-21-04,701
NOTE: If any dents or broken wires are found in the filter element screen, install new element.	

OIL FILTER ELEMENT - CLEANING AND PAINTING

1. Equipment and Materials

Clean deep pan or small pail

Petroleum Solvent, Specification AMS 3160, or equivalent

2. Referenced Procedure

49-21-04 Oil Filter Element - Inspection and Check

3. Cleaning/Painting

A. Cleaning

WARNING: USE PETROLEUM SOLVENTS ONLY IN A WELL-VENTILATED AREA AND WITH PROPER PRECAUTIONS TO PREVENT FIRE.

WEAR GOGGLES WHEN USING COMPRESSED AIR TO DRY PARTS. WARN OTHER PERSONS TO KEEP AWAY FROM HAZARDOUS AREA.

(1) Agitate the filter element in clean, unused, petroleum solvent for approximately 5 minutes. Allow element to stand until dry, or use clean, dry, filtered, compressed air at not over 50 psi to accelerate drying.

(2) Inspect the filter element (Ref. 49-21-04). If element does not pass inspection, send it to an overhaul facility for ultrasonic cleaning.

ENGINE STARTER DRIVE OIL SEAL - REMOVAL AND INSTALLATION

1. Equipment and Materials

R Drift, Gearshaft Oil Seal, CPWA 30075, or equivalent

R Oil Seal (Ref. Fig. 401)

R Preformed Packing (Ref. Fig. 401)

R Puller, Gearshaft Oil Seal Carrier, CPWA 30046-52, or equivalent

2. Referenced Procedure

49-41-04 Engine Starter - Removal and Installation

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker BAT PWR (B10).

(2) Remove APU starter (Ref. 49-41-04).

(3) Remove oil seal carrier retaining ring (Ref. Fig. 401).

(4) Using puller CPWA 30046-52, withdraw seal carrier from gearbox housing.

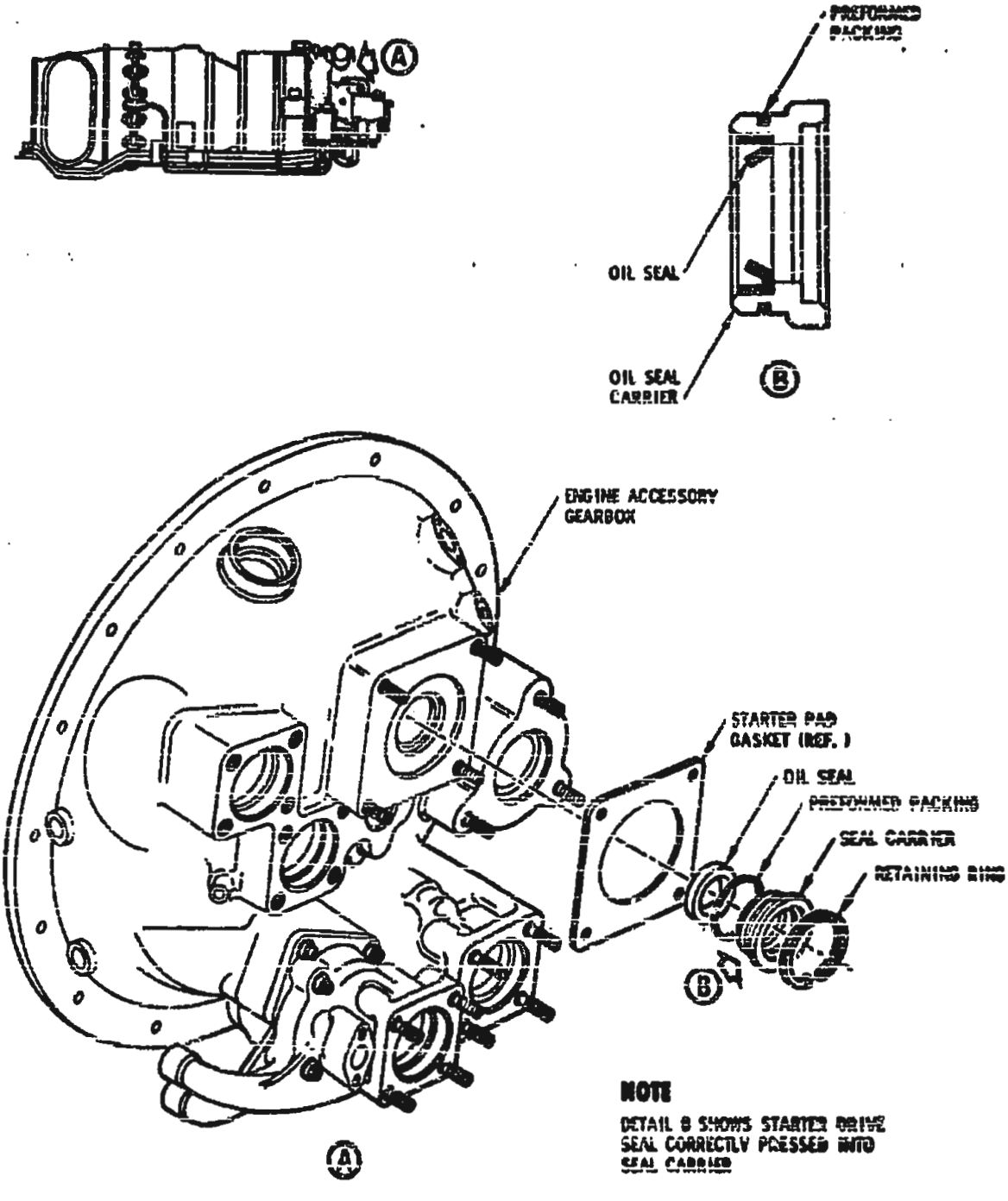
(5) Separate oil seal and preformed packing from carrier. Discard oil seal and packing.

B. Installation

(1) Moisten new oil seal with APU engine oil and gently press seal into carrier until correctly seated. Use hand pressure only. Do not use bench press (Ref. Fig. 401).

(2) Moisten new preformed packing with APU engine oil and install seal on carrier.

(3) Using drift, CPWA 30075, install seal carrier in gearbox housing and secure in place with retaining ring.



R Engine Starter Drive Oil Seal - Removal and Installation
R Figure 401

R (4) Install APU starter (Ref. 49-41-04).

(5) Remove tag and close circuit breaker opened in Step 3A(1).

NOTE: It is recommended that the APU be operated with the starter drive pad oil drain line temporarily disconnected at the drip tank and checked for an abnormal amount of leakage (more than 3 cc/hr) to verify proper oil seal installation.

ENGINE BLEED VALVE AIR FILTER ELEMENT - REMOVAL AND INSTALLATION

1. Equipment and Materials

Filter Element (Ref. Fig. 401)

Preformed Packing, Filter Element (Ref. Fig. 401)

Preformed Packing, Filter Bowl to Filter Head (Ref. Fig. 401)

Back-up Ring, Filter Bowl to Filter Head (Ref. Fig. 401)

Cleaning Solvent, Acetone (Fed. Spec. O-A-51) or Trichloroethylene (Fed. Spec. O-T-634 Type II)

Lock-wire, Fed. Spec. QQ-W-390, 0.032-inch diameter, or equivalent

Lubricant, Dow Corning 44A, (Dow Corning, Midland, Michigan 48641), or equivalent

R Lubricant, Petrolatum Graphite (MIL-T-5544), or equivalent

2. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breakers B9 through B17.

(2) Open APU compartment access doors 319AL and 319CL.

(3) Remove filter bowl (Ref. Fig. 401).

R R R NOTE: If filter assembly is a Bendix unit, remove spacer from bottom of bowl and retain for installation.

(4) Remove filter element.

R R R (5) Remove and discard preformed packing and back-up ring (Bendix and Puralator configurations), from filter head.

NOTE: Do not discard removed filter element; element is reusable and should be sent to an appropriate shop facility for cleaning.

WARNING: AVOID PROLONGED SKIN CONTACT OR INHALATION OF CLEANING FLUID FUMES.

(6) Clean filter head and bowl with cleaning solvent.

B. Installation

(1) Apply a light film of Dow Corning 44, or equivalent lubricant to new preformed packing. Install packing and backup ring as shown in Figure 401.

NOTE: Filter assemblies manufactured by PURAFLOW do not use back-up ring.

(2) Apply a light film of lubricant to new preformed packing and install in filter element. Install element in filter head.

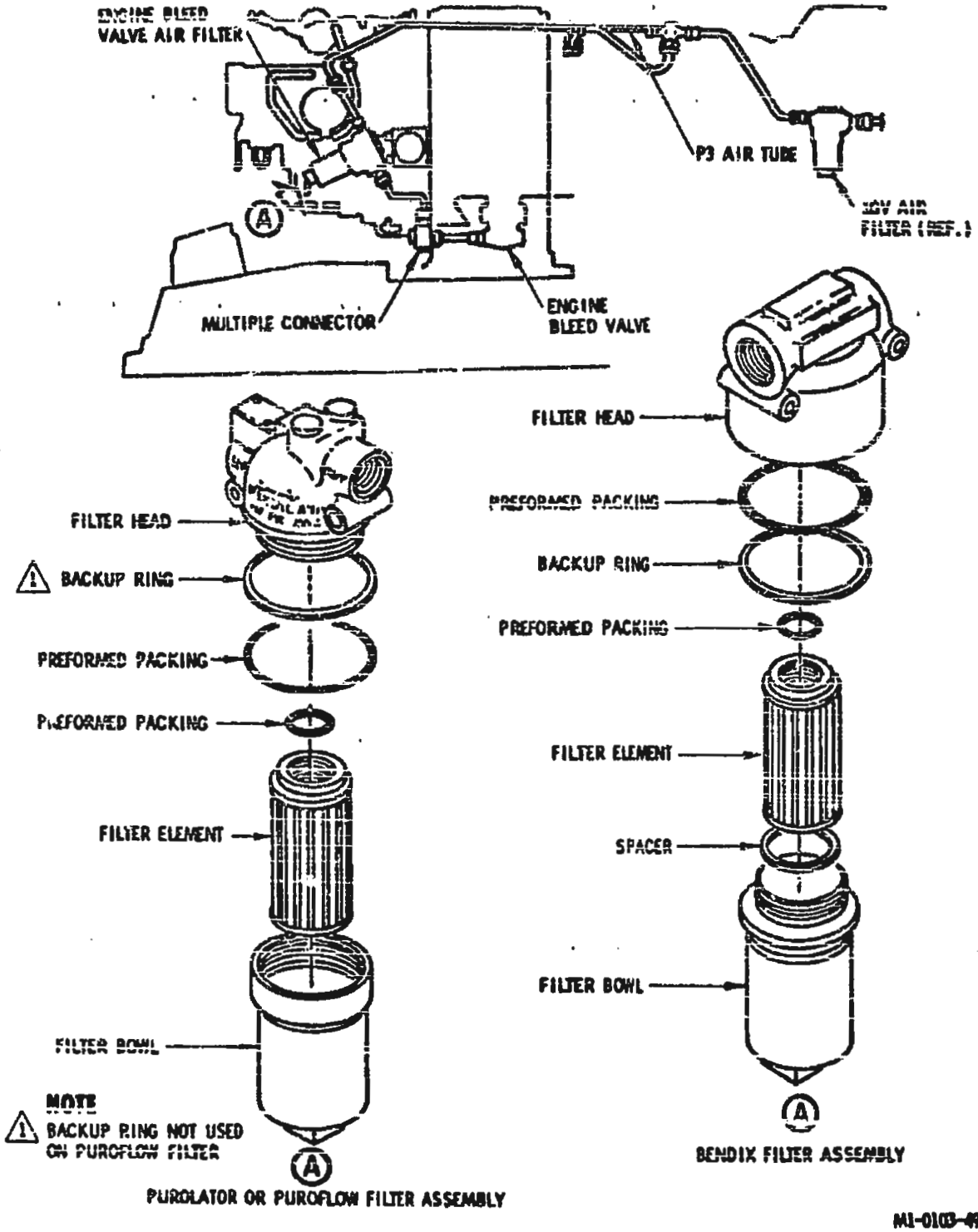
(3) If filter assembly is a Bendix unit, position spacer in bottom of bowl.

(4) Apply a light film of petrolatum graphite (or equivalent) lubricant to threaded area of filter head and install filter bowl.

R (5) Tighten bowl to a torque of 20 lb in. maximum and lockwire bowl to head with 0.032-inch diameter wire.

(6) Close APU compartment access doors.

(7) Remove tag and close circuit breakers opened in Step 2A(1).



R R Filter Element - Removal and Installation
Figure 401

EFFECTIVITY: ALL

CR ENGINE BLEED VALVE MULTIPLE CONNECTOR
CR MAINTENANCE NOTES, DATA, TOLERANCES AND REGULATIONS

CR 1. Bleed Valve Filter Orifice Contamination/Restriction

CR A. If the filter or primary orifice becomes contaminated it CR will reduce the amount of air controlling the bleed valve CR causing the valve to remain open, resulting in a low power CR engine with high TGT and low or marginal duct pressure.

CR (1) To check the bleed valve of an engine exhibiting those CR symptoms perform the following steps:

CR (a) Operate the APU in NORMAL mode noting the TGT.

CR (b) Slowly close off the final orifice opening in the CR multiple connector and note TGT.

CR NOTE: Hot air will be coming out of the final CR orifice - use a glove or rag to seal the CR orifice opening.

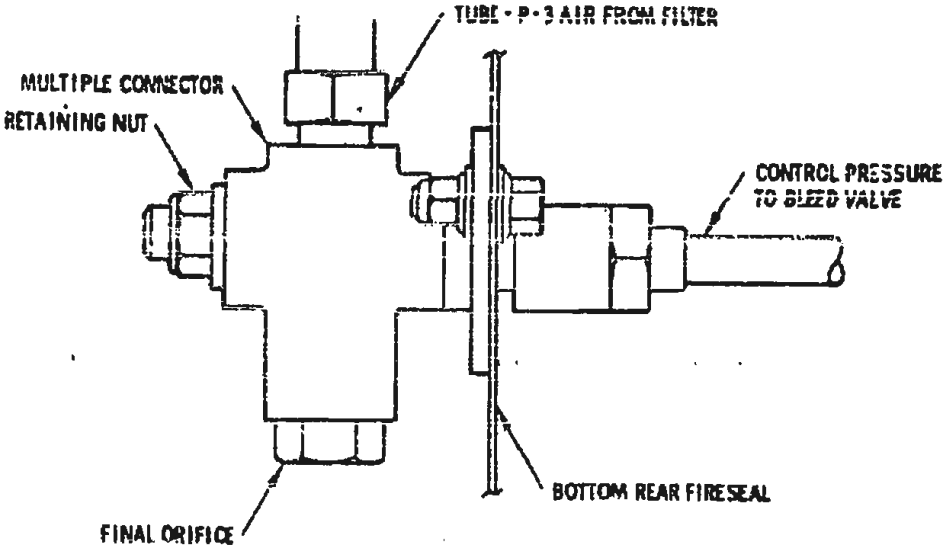
CR (c) Compare the TGT readings in Step (a) and (b).

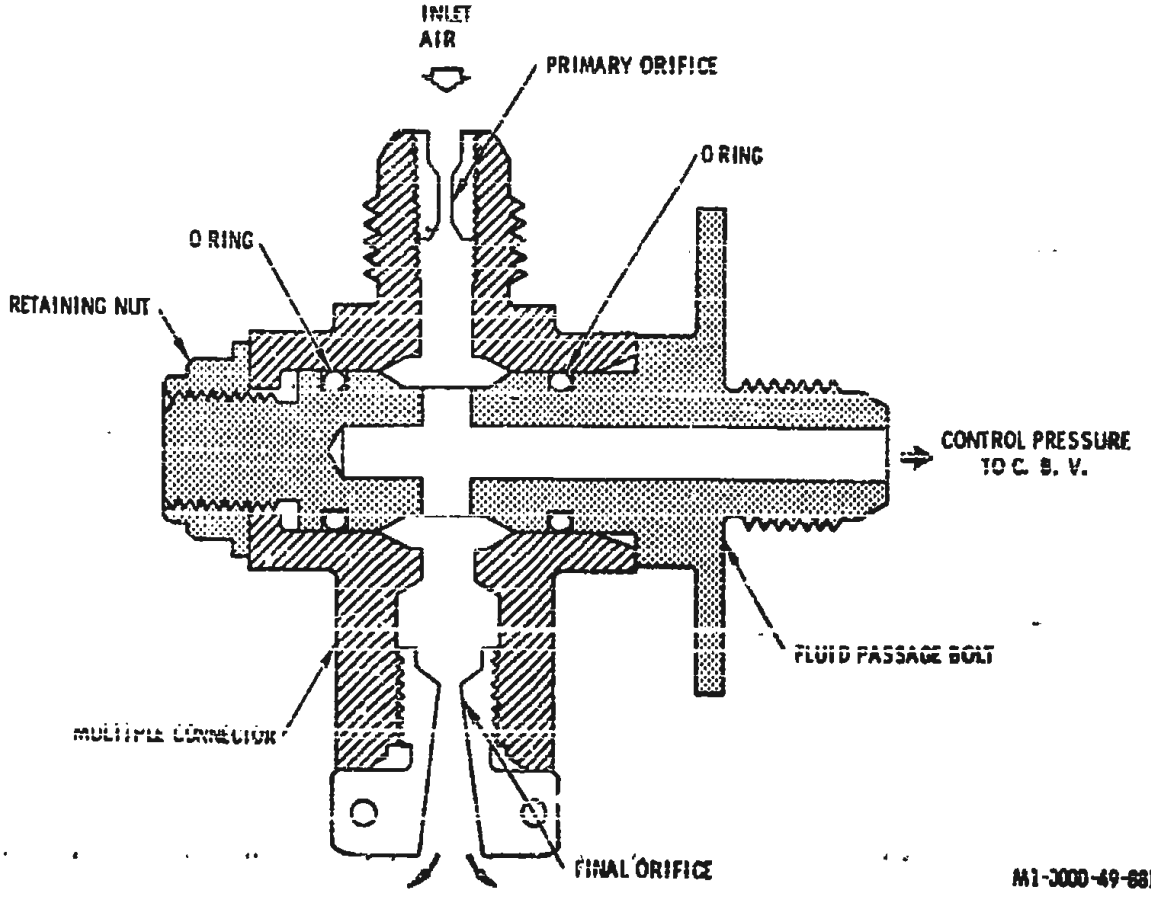
CR 1) The TGT will not change if the bleed valve is CR functioning properly.

CR 2) If the TGT decreases in Step (a) then the CR bleed valve was remaining open. The compressor CR bleed valve filter should be replaced and the CR primary orifice cleaned.

CR a) The orifices may be cleaned by removing CR the tube between the filter and the multiple CR connector. Then remove the retaining nut and CR slide the multiple connector off the fulid CR passage bolt. Clean the orifices with a CR solvent, such as perchlorethylene, and dry CR with clean air. Replace the O-rings on the CR bolt, slide the multiple connector over the CR bolt, secure with retaining nut and reinstall CR the air line.

CR NOTE: Do not use wire or drill rod to clean the CR orifices as it will increase the orifice CR size causing a bleed valve schedule shift.





CR
CR

APU Compressor Bleed Valve Orifice Location
Figure 201

R
R
001B

EFFECTIVITY: ALL

R ENGINE BLEED VALVE MULTIPLE CONNECTOR - REMOVAL AND INSTALLATION

R 1. General

R The following instructions contain procedures for removal of the
R engine bleed valve multiple connector for the purpose of
R replacement or cleaning the P3 air inlet and air bleed orifices,
R and reinstallation of the connector on the air passage bolt
R portion of the unit which remains attached to the air inlet
R plenum.

R 2. Referenced Procedure

R 49-21-09 Engine Bleed Valve Multiple Connector - Cleaning
R and Painting

R 3. Equipment and Materials

R Preformed Packing (Ref. Fig. 401)

R Lock-wire Fed. Spec. MS20995C32, or equivalent

R 4. Removal/Installation

R A. Removal

R (1) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag circuit breakers B9
R through B17.

R (2) Open left forward and aft APU compartment access doors.

R (3) Back off P3 air tube coupling nut (Ref. Fig. 401).
R Loosen coupling nut at bleed valve air filter as
R necessary to permit disengagement of tube from
R connector.

R (4) Remove connector retaining nut and pull connector body
R off of the air passage bolt attached to the air plenum
R wall.

R (5) Remove and discard the two preformed packings installed
R on the air passage bolt.

R (6) Clean the connector body orifices and fluid passage
R bolt (Ref. 49-21-09 Engine Bleed Valve Multiple
R Connector - Cleaning and Painting).

R EFFECTIVITY: ALL

R B. Installation

R (1) Install two new preformed packings on the air passage R bolt (Ref. Fig. 401).

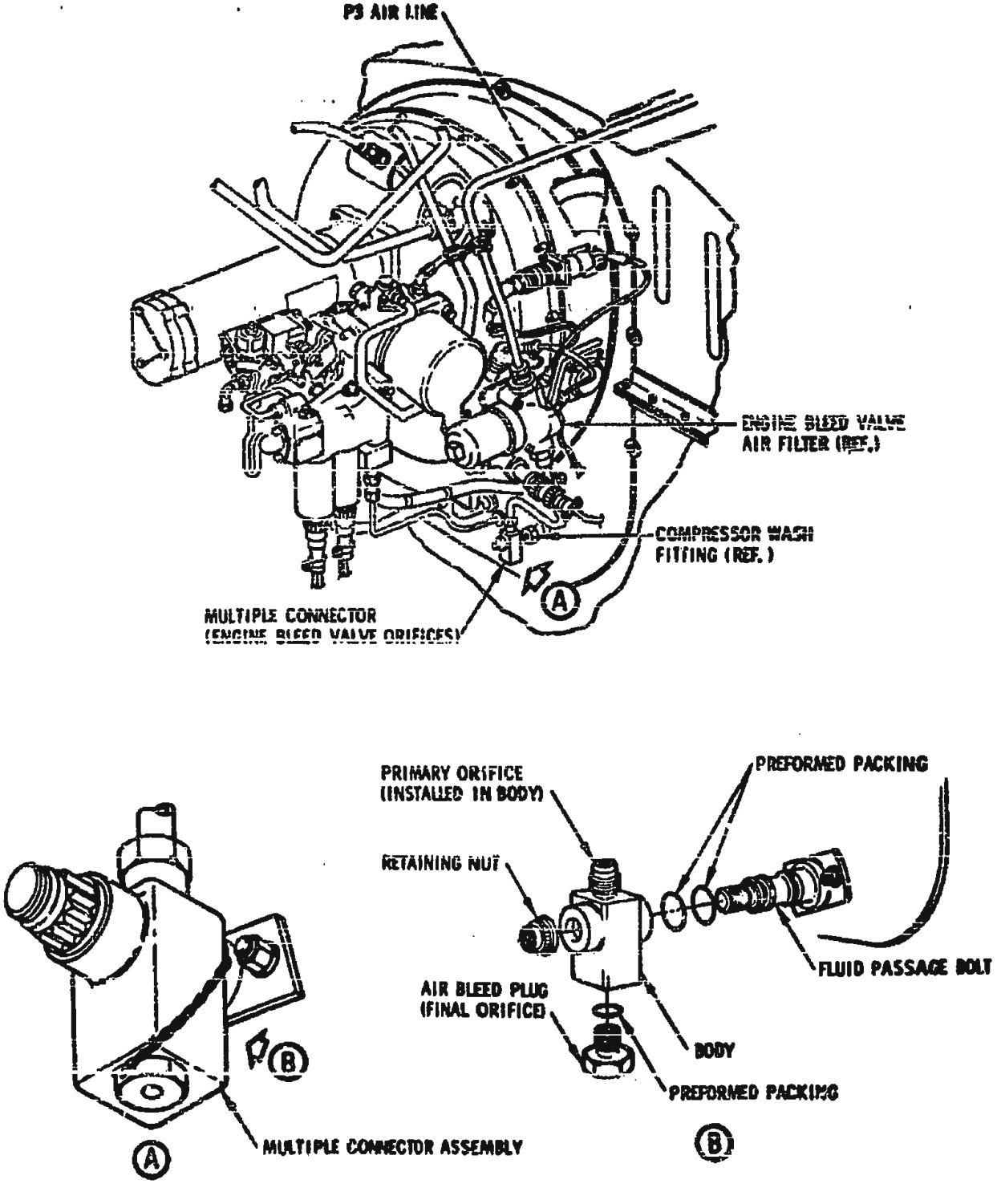
R (2) Install connector on air passage bolt and engage P3 air R tube coupling nut. Tighten coupling nuts at both ends R of tube fingertight.

R (3) Install connector retaining nut. Tighten nut to a R torque of 50 to 70 lb in. while securely holding R connector to prevent rotation and misalignment with P3 R air tube.

R (4) Tighten P3 air tube coupling nuts to torque of 180 to R 200 lb in. and lockwire.

R (5) Close APU compartment access doors and rotate fluid R catcher aft against APU access door.

R (6) Remove tags and close circuit breakers opened in Step R 3A(1).



R R Engine Bleed Valve Multiple Connector - Removal and Installation
Figure 401

R R EFFECTIVITY: ALL

001B

ENGINE BLEED VALVE MULTIPLE CONNECTOR - CLEANING AND PAINTING

1. Equipment and Materials

Lock-wire Fed. Spec. MS20995C32, or equivalent

Petroleum solvent, Aerospace Materials Spec. AMS 3160, or equivalent

R Aerosol Cleaning Solution, Swish Electrokleen (Montgomery Chemical Co., Gloucester N.J. 08030) is an approved equivalent)

Pre-formed Packing (Ref. Fig. 701)

2. Referenced Procedures

49-21-08	Engine Bleed Valve Air Filter Element - Removal and Installation
49-21-09	Engine Bleed Valve Multiple Connector - Removal and Installation

3. Cleaning

(1) Remove multiple connector (Ref. 49-21-09).

(2) Remove air bleed plug (Ref. Fig. 701).

(3) Clean connector body and orifices using cleaning solvent/degreaser.

NOTE: Use a pipe cleaner or equivalent swabbing tool to clean primary and air bleed plug orifices. Do not use wire or any object that could scratch or in any way alter the size or smooth surfaces of the orifices.

(4) Clean the connector air passage bolt attached to the APU air inlet plenum.

(5) Remove P3 filtered air tube between filter and multiple connector and clean tube.

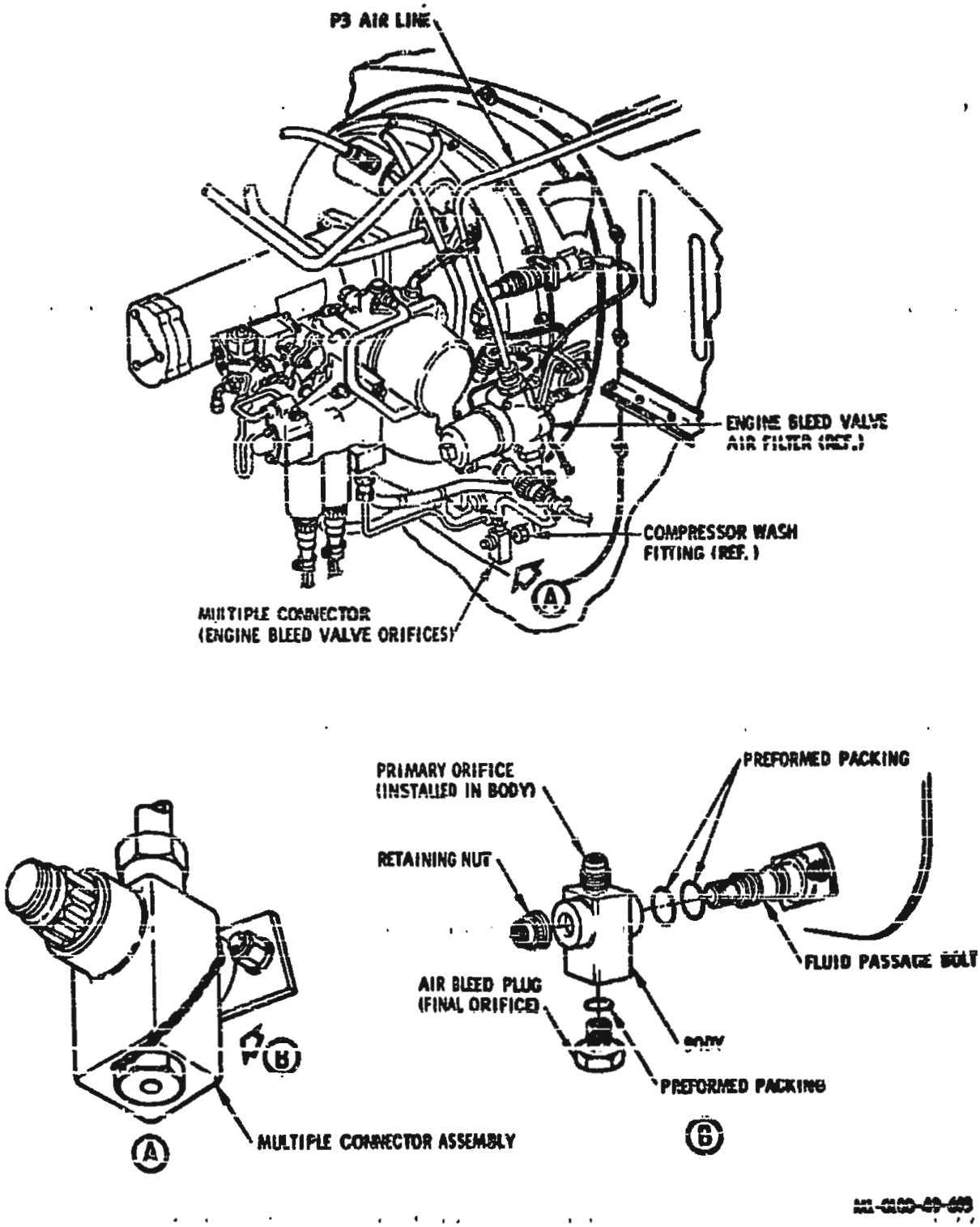
(6) Dry all parts using clean shop air.

(7) Reconnect filtered air tube to filter head assembly.

(8) Reinstall air bleed plug using new pre-formed packing and safety plug with lock-wire (Ref. Fig. 701).

(9) Reinstall multiple connector (Ref. 49-21-09).

(10) Replace engine bleed valve air filter element (Ref. 49-21-08).



Engine Bleed Valve Multiple Connector
Figure 701

ENGINE FUEL CONTROL - DESCRIPTION AND OPERATION

1. General

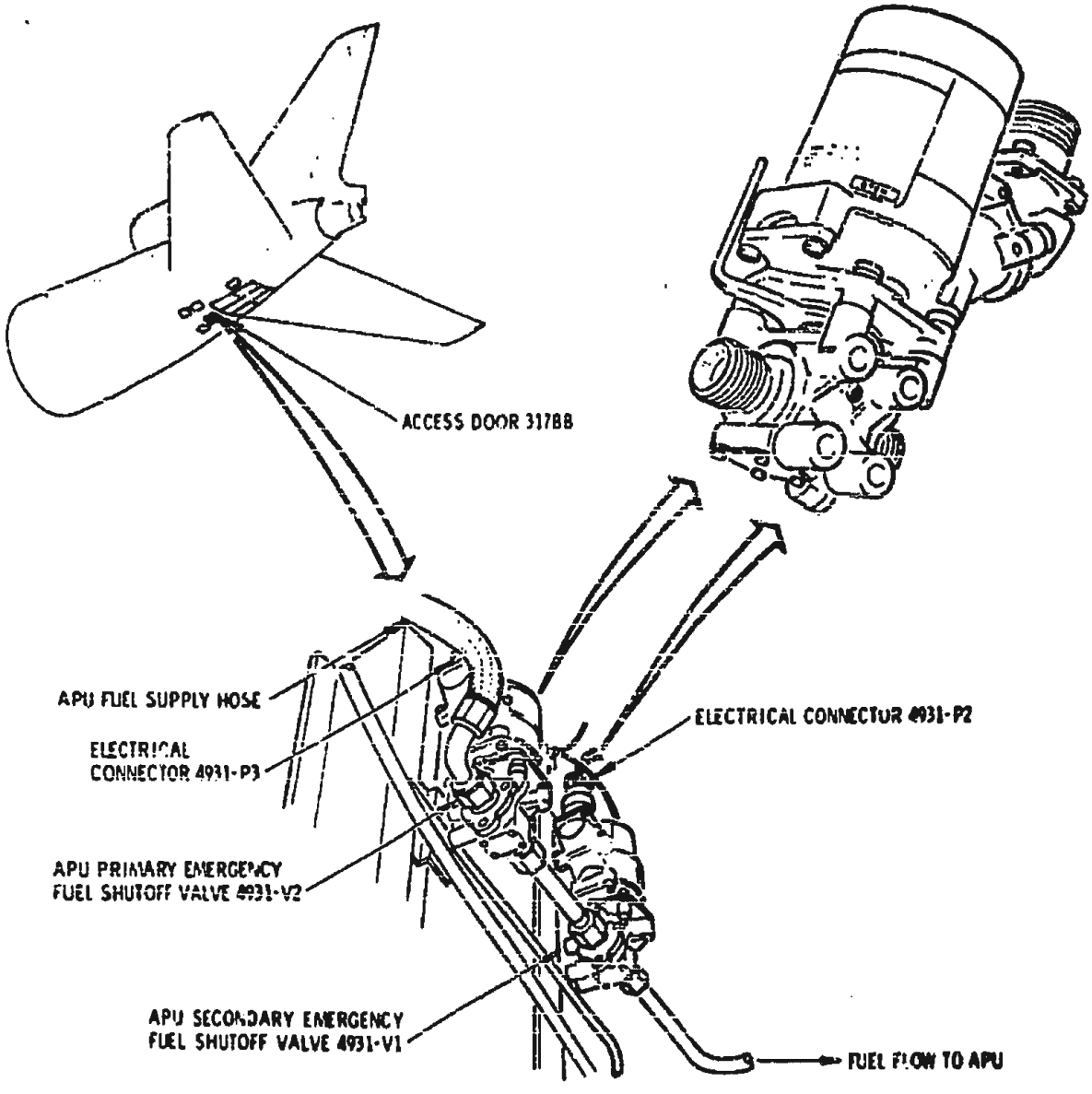
R Fuel is supplied to the Auxiliary Power Unit (APU) through a flexible hose connected to a fitting in the No. 2 engine fuel feed line just aft of the cabin pressure bulkhead and two electrically operated primary and secondary emergency fuel shutoff valves (Ref. Fig. 1). The primary emergency fuel shutoff valve is normally closed and isolates the APU from its
R fuel supply source when it is not in operation. The valve is electrically opened when APU master power is applied. The secondary emergency fuel shutoff valve is normally open and serves as a redundant (backup) fuel shutoff device to assure shutoff of fuel to the APU during emergency shutdowns. Both valves are electrically closed by the the APU autofire shutdown circuitry and by manual actuation of the APU FIRE PULL handles on the Flight Engineer/Second Officers upper panel and external APU control panel. They may also be manually opened and closed if required during ground maintenance.

R NOTE: The primary emergency fuel shutoff valve is closed by 28V
R DC from the DC Bus 2 or the DC Ground Service Bus. The valve will, therefore, remain open when APU master power is switched off with only BAT BUS power available.

Fuel is normally supplied to the No. 2 engine fuel feed line from tank 2L and 2R through the normally open ENG 2 TANK VALVE. The tank valve must, therefore, always be open when the APU is operated, even though the No. 2 engine is shut down or isolated from its fuel supply. This is possible, even though the No. 2 engine FIRE PULL handle is pulled, as the ENG 2 TANK VALVE is controlled only by the ENG 2 TANK VALVE switchlight and is not affected by actuation of the FIRE PULL handle (Ref. 28-25-00).

From the outlet port of the secondary emergency fuel shutoff valve, fuel is routed to a fitting on the forward bulkhead of the APU compartment. A flexible hose (supplied with the APU) routes fuel from the bulkhead fitting to the APU fuel inlet port on the oil-to-fuel heater mounted on the engine accessory gearbox. From the fuel heater, fuel flows through an external tube to the engine-driven fuel pump and filter assembly.

Fuel system components on the APU consist of the oil-to-fuel heater, an integral engine-driven fuel pump and filter assembly, fuel control unit, free turbine speed controller, automatic fuel shutoff valve assembly, flow divider and dump valve, dual fuel manifold containing seven primary and seven secondary fuel nozzles, and fuel drain collecting (drip) tank.


ACCESS DOOR 3178B
APU FUEL SUPPLY HOSE
ELECTRICAL CONNECTOR 4931-P3
APU PRIMARY EMERGENCY FUEL SHUTOFF VALVE 4931-V2
APU SECONDARY EMERGENCY FUEL SHUTOFF VALVE 4931-V1
ELECTRICAL CONNECTOR 4931-P2
FUEL FLOW TO APU

APU PRIMARY AND SECONDARY EMERGENCY FUEL SHUTOFF VALVES
(VIEW THROUGH ACCESS 3178B)

M1-0100-49-657

APU Primary and Secondary Emergency Fuel Shutoff Valves
Figure 1

On aircraft 001-031 having an APU not modified by HS SB49-105,
a flight station advisory light indication of a contaminated fuel filter is provided by a clogged fuel filter sensing switch which senses the differential pressure across the fuel filter.

2. Engine-Driven Fuel Pump

A. Description

An engine-driven, single element, positive displacement, gear type fuel pump containing a disposable 10-micron filter element and a fuel filter bypass valve is mounted on the APU engine accessory gearbox (Ref. Fig. 2 and 3). The bypass valve will direct fuel around the filter in event filter contamination is sufficient to cause a pressure drop of 2.7 to 3.0 psid across the element. Access to the filter element is acquired by removing a filter housing that is bolted to the pump body. A drain plug at the bottom of the housing is provided for draining the housing before removal.

A mounting pad and studs on the pump body support the fuel control unit and automatic fuel shutoff valve assembly. Fuel pump outlet and bypass fuel return passages in the pump body are aligned with mating passages in the fuel control unit and automatic fuel shutoff valve assembly.

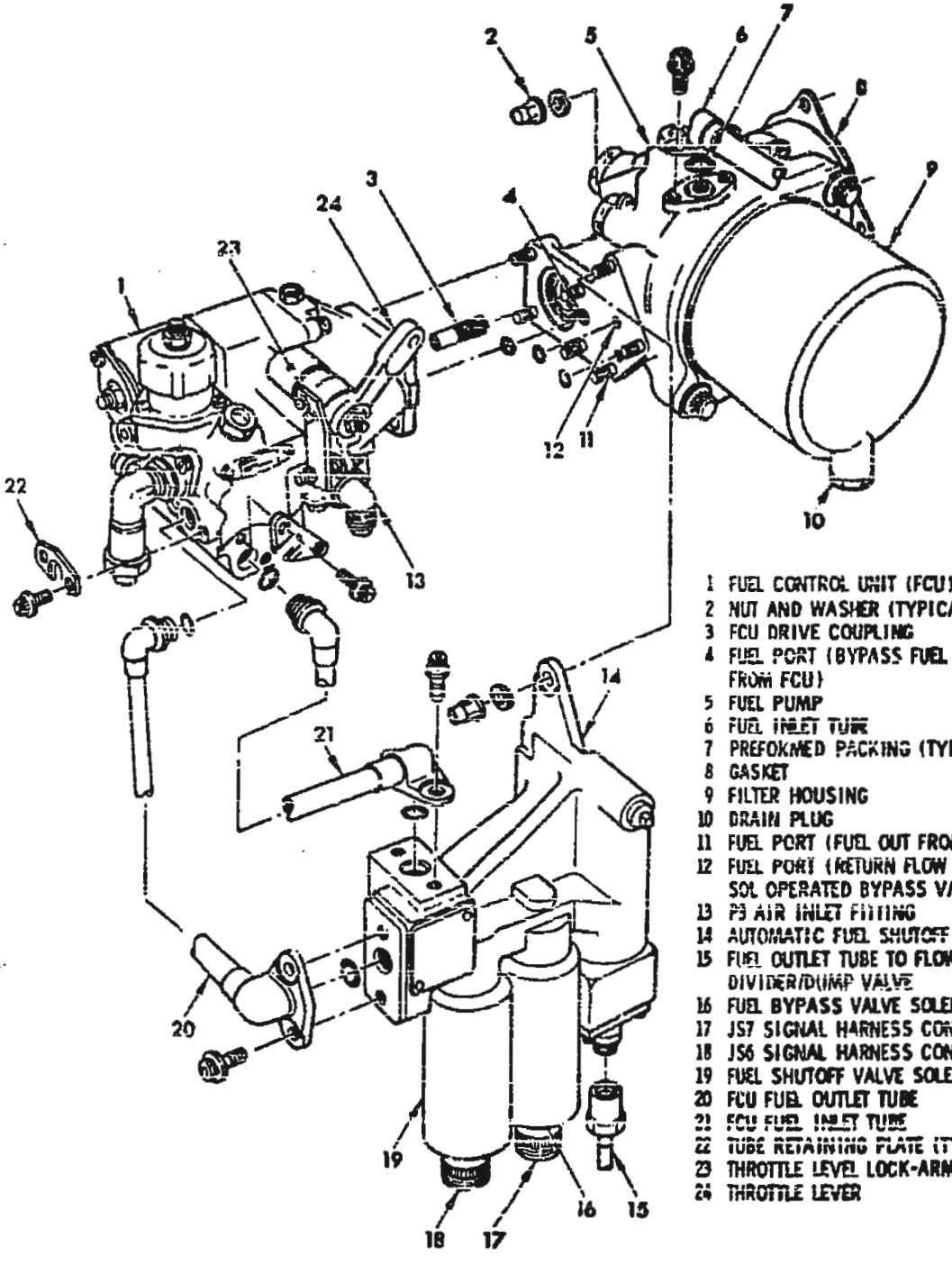
B. Operation

In operation, the pump draws fuel from the No. 2 engine fuel feed line through the 10-micron filter and delivers it under pressure through passages in the automatic fuel shutoff valve assembly to the fuel control unit (Ref. Fig. 3). Fuel delivered in excess of engine requirements is returned through a port in the fuel control unit mounting pad to the pump inlet. A high pressure relief valve in the fuel control unit bypasses fuel to the pump inlet when pump outlet pressure exceeds 950 psig. Fuel returned to the pump inlet is passed through an ejector nozzle which maintains a constant head of fuel at the pump inlet. The fuel filter bypass will direct fuel around the filter element when the element becomes sufficiently contaminated to cause a pressure drop of 2.7 to 3.0 psid across the filter.

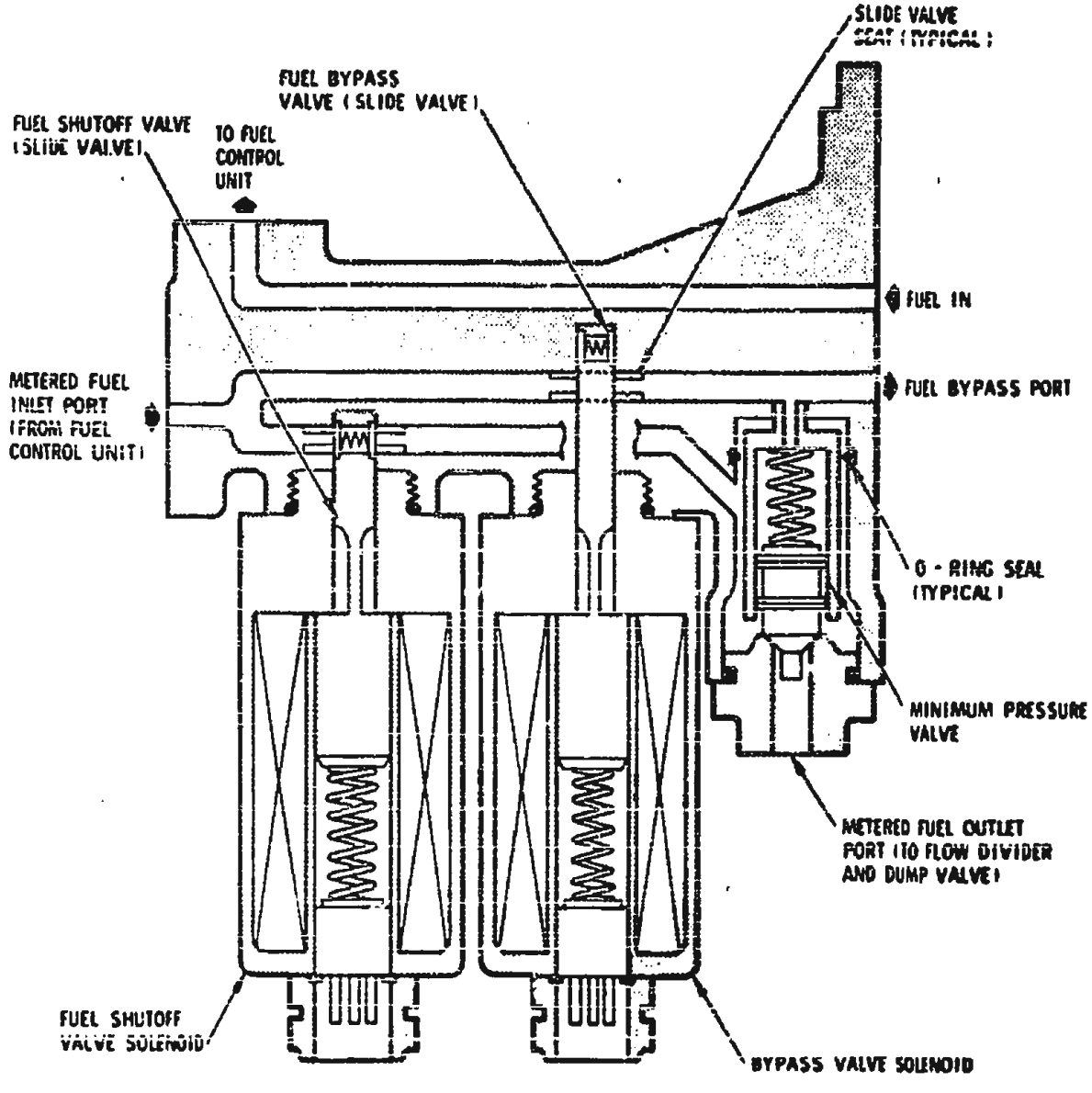
CR
CR
CR
CR

3. Automatic Fuel Shutoff Valve Assembly

A. Description


1 FUEL CONTROL UNIT (FCU)
2 NUT AND WASHER (TYPICAL)
3 FCU DRIVE COUPLING
4 FUEL PORT (BYPASS FUEL FROM FCU)
5 FUEL PUMP
6 FUEL INLET TUBE
7 PREFORMED PACKING (TYPICAL)
8 GASKET
9 FILTER HOUSING
10 DRAIN PLUG
11 FUEL PORT (FUEL OUT FROM PUMP)
12 FUEL PORT (RETURN FLOW FROM SOL OPERATED BYPASS VALVE)
13 P3 AIR INLET FITTING
14 AUTOMATIC FUEL SHUTOFF VALVE
15 FUEL OUTLET TUBE TO FLOW DIVIDER/DUMP VALVE
16 FUEL BYPASS VALVE SOLENOID
17 JS7 SIGNAL HARNESS CONNECTOR
18 JS6 SIGNAL HARNESS CONNECTOR
19 FUEL SHUTOFF VALVE SOLENOID
20 FCU FUEL OUTLET TUBE
21 FCU FUEL INLET TUBE
22 TUBE RETAINING PLATE (TYPICAL)
23 THROTTLE LEVEL LOCK-ARM
24 THROTTLE LEVER

APU Fuel Pump, Fuel Control Unit, and Automatic Fuel Shutoff Valve
Figure 2 (Sheet 1)


SLIDE VALVE SEAT (TYPICAL)
FUEL BYPASS VALVE (SLIDE VALVE)
FUEL SHUTOFF VALVE (SLIDE VALVE)
TO FUEL CONTROL UNIT
FUEL IN
METERED FUEL INLET PORT (FROM FUEL CONTROL UNIT)
FUEL BYPASS PORT
O-RING SEAL (TYPICAL)
MINIMUM PRESSURE VALVE
METERED FUEL OUTLET PORT (TO FLOW DIVIDER AND DUMP VALVE)
FUEL SHUTOFF VALVE SOLENOID
BYPASS VALVE SOLENOID

APU Fuel Pump, Fuel Control Unit, and Automatic Fuel Shutoff Valve
Figure 2 (Sheet 2)

The automatic fuel shutoff valve assembly (Ref. Fig. 2) is mounted on the engine-driven fuel pump next to the fuel control unit. The unit consists of a solenoid-operated fuel shutoff valve, a solenoid-operated fuel bypass valve, and a spring-loaded poppet minimum pressure valve. The fuel shutoff valve, which is open during APU operation, provides a positive rapid shutoff of fuel when the APU is shutdown. The bypass valve, which is closed during APU operation, is simultaneously opened to provide a bypass port for metered fuel back to the pump inlet. The minimum pressure valve prevents fuel flow to the engine until sufficient back pressure exists in the fuel outlet line for the fuel control unit to establish metered fuel flow.

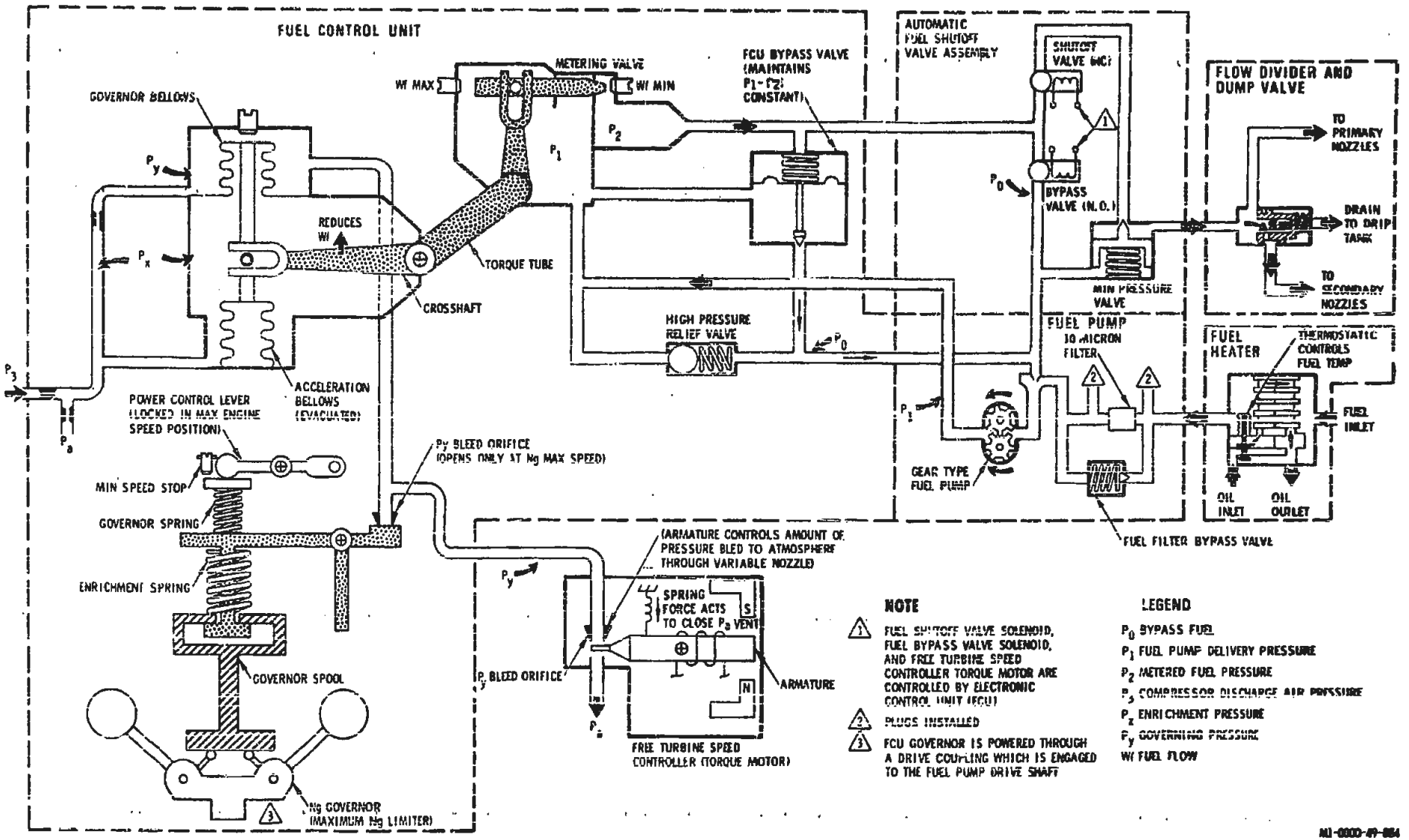
NOTE: Fuel shutoff and bypass valve solenoids, though identical in appearance, are not interchangeable. The bypass valve is installed between the fuel shutoff solenoid and the fuel filter housing. An electrical receptacle on the valve, is configurated to mate with the APU signal harness connector JS7. The fuel shutoff solenoid receptacle is configurated to mate with harness connector JS6.

B. Operation

During the initial stages of an APU start (Ref. Fig. 3), the fuel shutoff and fuel bypass valve solenoids are deenergized. The fuel shutoff valve is closed and the fuel bypass valve is open. As the starter begins to motor the engine, fuel pumped through the fuel control unit is bypassed back to the pump inlet through the open bypass valve. Bypass fuel pressure (Po), applied through a restricted passage to the back side of the minimum pressure valve, aids the valve poppet spring in keeping the valve closed. At 10 percent Ng, the APU electronic control unit activates the ignition exciter and energizes the fuel shutoff and fuel bypass valve solenoids. The fuel shutoff valve opens and the fuel bypass valve closes. The minimum pressure valve opens when metered fuel pressure between the fuel control unit and valve is a minimum of 80 psi higher than the fuel bypass line pressure (Po) and spring pressure applied to the back side of the valve. With the minimum pressure valve open, fuel is directed through an external fuel line to the flow divider and dump valve which directs it into the fuel nozzle manifold.

R

When the APU is shut down, the electronic control unit deenergizes the fuel shutoff and bypass valve solenoids. The fuel shutoff valve closes and the fuel bypass valve opens. Metered fuel is bypassed through the fuel bypass line to the pump inlet. The pressure in the fuel delivery

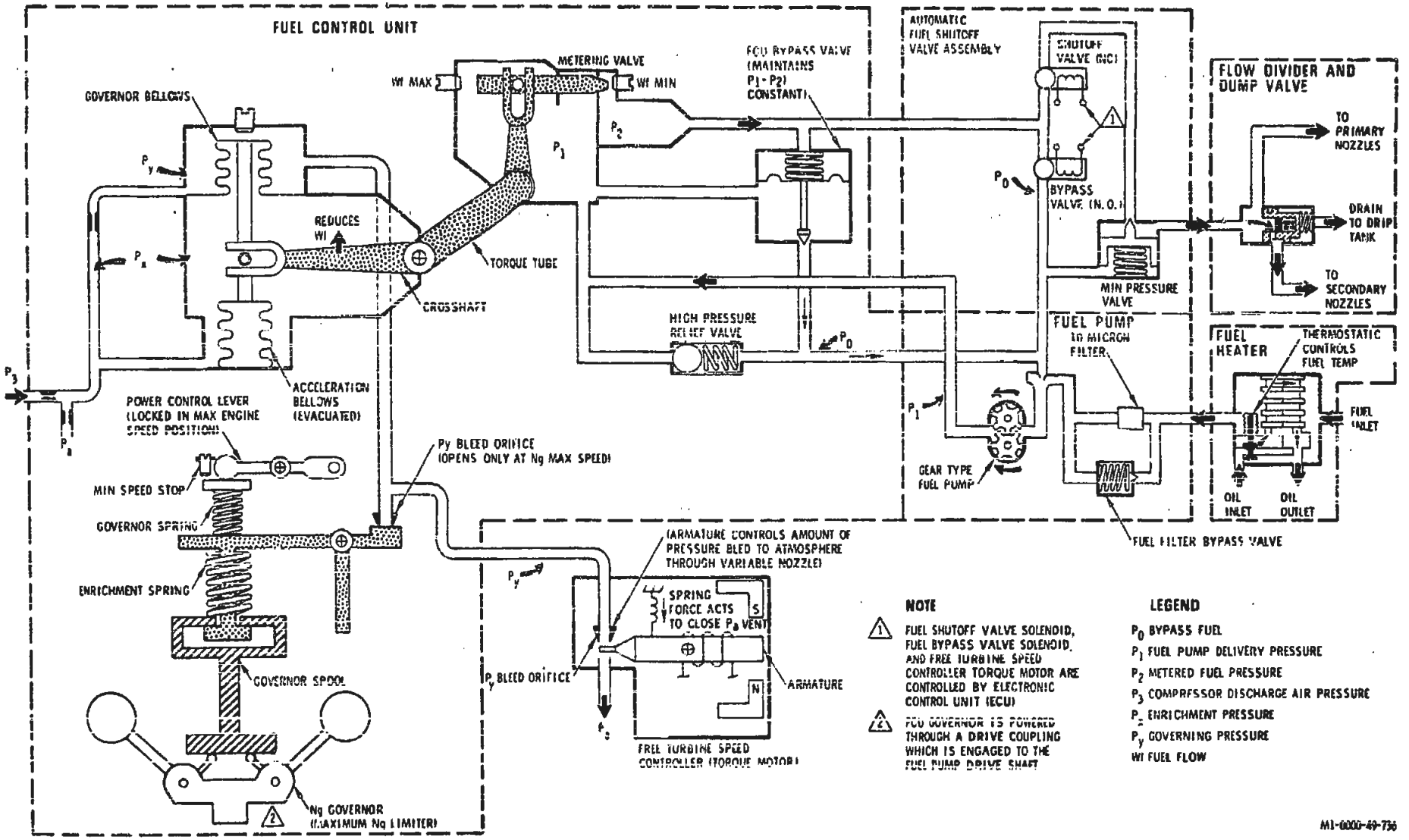


APU Fuel System Diagram
Figure 3

CR
CR

EFFECTIVITY: 001-031

001B


FUEL CONTROL UNIT
GOVERNOR BELLOWS
METERING VALVE
Wf MAX
Wf MIN
FCU BYPASS VALVE (MAINTAINS P1-P2 CONSTANT)
REDUCES Wf
TORQUE TUBE
CROSSHAFT
HIGH PRESSURE RELIEF VALVE
ACCELERATION BELLOWS (EVACUATED)
POWER CONTROL LEVER (LOCKED IN MAX ENGINE SPEED POSITION)
MIN SPEED STOP
GOVERNOR SPRING
ENRICHMENT SPRING
GOVERNOR SPOOL
Py BLEED ORIFICE (OPENS ONLY AT Ng MAX SPEED)
Ng GOVERNOR (MAXIMUM Ng LIMITER)
(ARMATURE CONTROLS AMOUNT OF PRESSURE BLED TO ATMOSPHERE THROUGH VARIABLE NOZZLE)
SPRING FORCE ACTS TO CLOSE Pa VENT
ARMATURE
FREE TURBINE SPEED CONTROLLER (TORQUE MOTOR)
AUTOMATIC FUEL SHUTOFF VALVE ASSEMBLY
SHUTOFF VALVE (NC)
BYPASS VALVE (N.O.)
MIN PRESSURE VALVE
FUEL PUMP
GEAR TYPE FUEL PUMP
FUEL FILTER BYPASS VALVE
FLOW DIVIDER AND DUMP VALVE
TO PRIMARY NOZZLES
DRAIN TO DRIP TANK
TO SECONDARY NOZZLES
FUEL HEATER
THERMOSTATIC CONTROLS FUEL TEMP
FUEL INLET
OIL INLET
OIL OUTLET
NOTE
1 FUEL SHUTOFF VALVE SOLENOID, FUEL BYPASS VALVE SOLENOID, AND FREE TURBINE SPEED CONTROLLER TORQUE MOTOR ARE CONTROLLED BY ELECTRONIC CONTROL UNIT (ECU)
2 FCU GOVERNOR IS POWERED THROUGH A DRIVE COUPLING WHICH IS ENGAGED TO THE FUEL PUMP DRIVE SHAFT
LEGEND
P0 BYPASS FUEL
P1 FUEL PUMP DELIVERY PRESSURE
P2 METERED FUEL PRESSURE
P3 COMPRESSOR DISCHARGE AIR PRESSURE
Pa ENRICHMENT PRESSURE
Py GOVERNING PRESSURE
Wf FUEL FLOW
M1-0000-49-736

APU Fuel System Diagram
Figure 3

EFFECTIVITY: 032-999

line to the flow divider and dump valve drops off and the minimum pressure valve closes.

4. Fuel Control Unit (FCU)

A. Description

Fuel is metered to the engine by a fuel control unit (FCU) mounted on the engine-driven fuel pump (Ref. Fig. 2 and 3). The unit consists of two major operational sub-sections: a pneumatically operated and controlled fuel metering section, and a centrifugal governor-operated gas generator (Ng) speed limiter that is driven by the fuel pump drive shaft. Its primary purpose is to control engine power by regulating the amount of fuel burned in the engine.

R Fuel is supplied to the fuel control unit by the engine-driven fuel pump through a passage in the automatic R fuel shutoff valve assembly. An external tube connects the R fuel shutoff valve assembly to the engine fuel control unit R (FCU). Metered fuel flows from the FCU through an external R tube to a minimum pressure valve within the automatic fuel R shutoff valve assembly. Fuel will not be admitted to the R engine until the fuel shutoff and bypass valve solenoids are energized (Ref. Para. 3).

R The fuel metering section consists of a metering valve, fuel bypass valve, pneumatic bellows unit, and fuel pressure R relief valve. The primary purpose of the fuel metering R section is to regulate the rate of fuel flow to the engine R and it does this by controlling the position of a fuel metering valve. A constant fuel pressure differential (P1-P2) is maintained across the metering valve by the FCU bypass valve. The rate of flow at which fuel is metered to the engine is then determined only by metering valve position.

R The pneumatic bellows unit consists of an evacuated acceleration bellows and a governor bellows. The governor bellows is secured at one end to the bellows unit housing and functions in a manner similar to a diaphragm. The acceleration bellows is evacuated and serves as an absolute R pressure reference. It (acceleration bellows) is connected to the governor bellows by a common rod that is engaged to a linkage consisting of a cross shaft, a torque tube, and associated linkage. Movement of the bellows rod is transmitted through the cross shaft and torque tube to the fuel metering valve. The torque tube forms the seal between the air and fuel sections of the control unit and is preloaded to provide a force that closes the metering valve.

This force is opposed by the bellows which exerts a force to open the valve.

The high fuel pressure relief valve is installed between the P1 fuel pump outlet pressure line and the Po fuel bypass line and prevents a build-up of excessive fuel pressure in the fuel control unit. The valve is designed to bypass fuel back to the pump inlet when pump outlet pressure rises above 950 psi.

The bypass valve senses fuel control unit outlet pressure (P2) and compares it with fuel inlet pressure (P1) across a spring-loaded, diaphragm-operated poppet valve. When the poppet is unseated, bypassed fuel (Po) is returned to the fuel pump inlet. The valve continuously seeks a position that will maintain a constant P1-P2 pressure differential across the metering valve, always bypassing fuel not required to maintain the flow rate dictated by metering valve position. Bimetallic discs under the bypass valve spring compensate for variations in fuel specific gravity due to changes in fuel temperature.

B. Operation

During APU operation, the amount of fuel metered to the engine, and the engine power output required to maintain free turbine speed at 33,000 rpm, is determined by the free turbine speed controller which indirectly controls the position of the fuel metering valve orifice in the FCU (Ref. Fig. 3 and Table 1). This is accomplished by controlling the amount of Governor Bellows Control air pressure (Py) bled from the FCU through a torque motor-controlled bleed air vent (Ref. Para. 4). The torque motor, in turn, is controlled by the ECU which integrates Ng speed, air inlet temperature, and free turbine speed input signals into a torque motor input signal reflecting engine power output requirements.

R Fuel flow rate scheduling during engine start and the
R limiting of maximum gas generator speed (above 102 percent Ng) are controlled by a centrifugal flyweight speed limiting governor. The governor flyweights are driven at a speed that is proportional to engine compressor-turbine spool rpm. As rpm is increased, the force developed by the flyweight mechanism is countered by two springs, an enrichment lever spring and a governor lever spring. Initial spring tension is set by the fuel control unit power control lever at a point corresponding to the maximum allowable compressor-turbine spool rpm. The governor thus functions only as a maximum speed limiting device and has no control over engine speed regulation during stabilized operation. The governor lever controls a bleed air orifice that bleeds

off Py air pressure in the bellows unit whenever the maximum allowable compressor-turbine spool (gas generator) speed is exceeded. Since the reduction of Py pressure in the fuel metering section of the fuel control unit is the primary means of reducing fuel flow to the engine, the engine is thus prevented from exceeding its maximum allowable rpm.

P3 (engine compressor discharge air pressure) is applied to the fuel control unit through an electrically heated tube and an air inlet fitting at the bottom of the fuel metering section. On APU engines having serial numbers higher than PC-E74298, and earlier units with P & WC SB49-41, this air is filtered by a 10-micron filter installed in heated P3 air line (Ref. Fig. 4). P3 pressure is reduced by an orifice in the air inlet fitting (Ref. Fig. 3). When further reduced
R by a fixed bleed air orifice, P3 pressure becomes Px
R pressure and is applied to the external surface of the acceleration bellows and the inside surface of the governor bellows. Px pressure, is also applied as Py pressure to the external surfaces of the governor bellows. Since the governor and acceleration bellows are connected by a common cross shaft, a portion of the Px pressure applied to the governor bellows is cancelled by the same force acting in opposition on an equal surface of the acceleration bellows. Because of the difference in effective areas acted upon by Px and Py pressures, changes in Py pressure will have a greater effect on the governor bellows than equivalent changes in Px pressure. Px and Py pressures will vary with changing engine operating conditions. When both pressures increase simultaneously (as during engine acceleration after a start), the governor bellows will cause the fuel metering valve to move in an opening direction, progressively increasing the rate of fuel flow to the engine. When both pressures are simultaneously reduced, the governor bellows will move the fuel metering valve to its minimum fuel flow position. This occurs during engine deceleration after initiation of a shutdown cycle.

Basic engine speed control is achieved by varying Py pressure. As Py pressure is increased, fuel flow is increased; as Py pressure is decreased, fuel flow decreases. Although Py pressure can be reduced by the governor lever-controlled Py bleed orifice, this occurs only when the governor senses an engine overspeed condition. At all other times, Py pressure is normally controlled by the free turbine speed controller through a torque motor operated Py bleed orifice in response to input signals from the APU electronic control unit. As the orifice is opened, Py pressure at the governor bellows is decreased and fuel flow is reduced. As the orifice is closed, Py pressure at the governor bellows is increased, and fuel flow is increased.

In the Ng governor section of the fuel control unit, rotation of the governor flyweights exerts an upward force against a governor spool which is spring-loaded against a governor lever. The governor lever, in turn, is spring-loaded against the fuel control unit power control lever which is locked in the maximum engine power position and controls the amount of air bled through a Py pressure bleed orifice. The governor spring applies a downward force against the governor lever. With the governor lever thus set for maximum engine power regulation, the Py bleed orifice will be opened only when the speed limiting governor is driven at an rpm proportionately higher than the maximum allowable gas generator (Ng) rpm. The governor is thus set to provide only gas generator overspeed protection. When the APU is started and gas generator rpm increases, centrifugal force causes the governor flyweights to apply an increasingly upward force against the governor spool. As Ng increases, the governor spool will continue to move upward until it contacts the governor lever. As Ng continues to increase, the upward force exerted by the flyweight is transmitted through the governor spool to the governor lever until countered by governor spring tension. The governor lever will open the Py bleed orifice only when gas generator rpm begins to exceed the maximum allowable and results in sufficient increase in flyweight force to overcome the governor spring. At that time the governor lever opens the Py bleed orifice to reduce Py pressure and fuel flow to the engine.

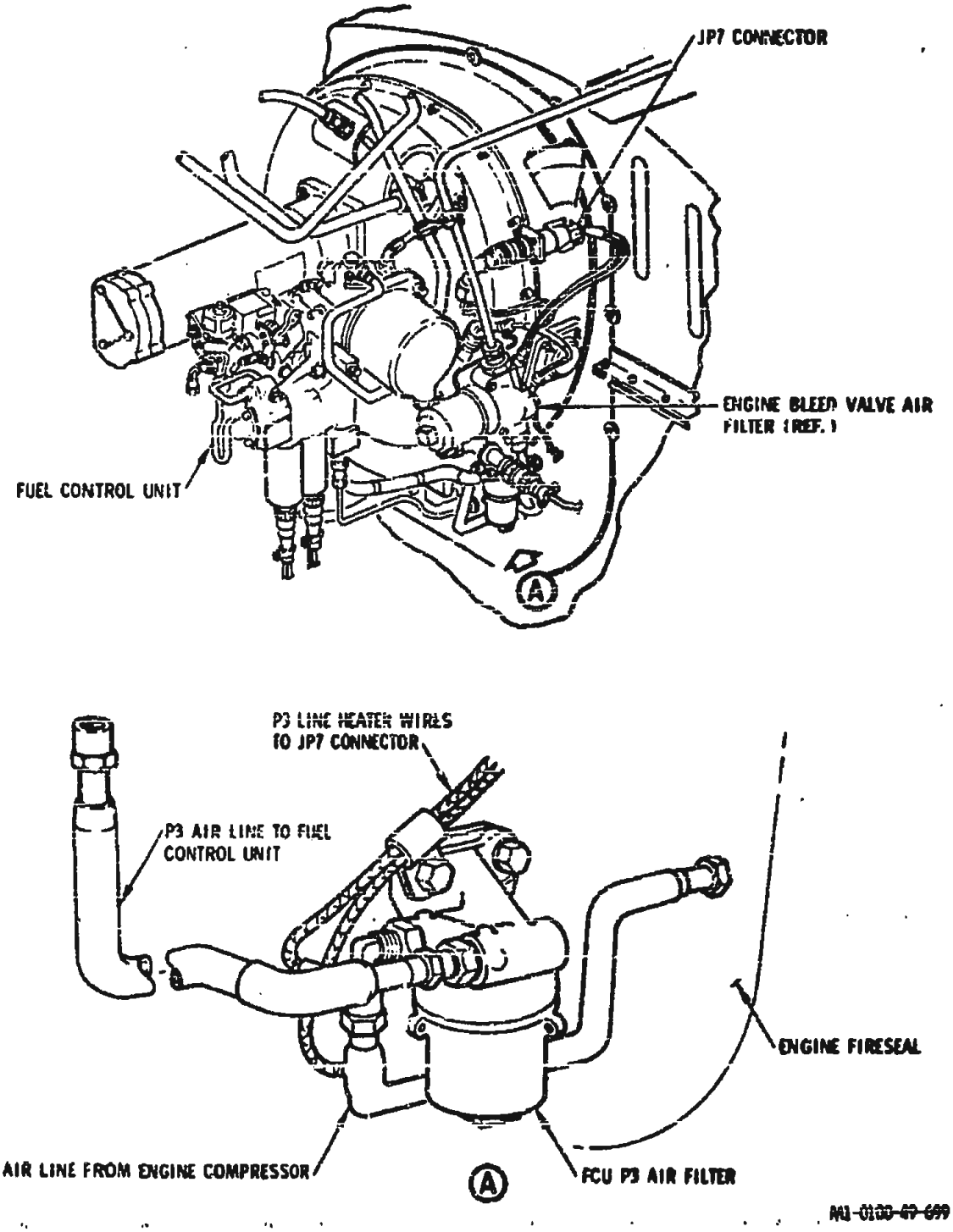
Fuel Control Unit Parameters
Table 1

PARAMETER	VALVE
Metered Fuel Flow	76 lbs/hr (Minimum)
Metering Valve Differential Pressure	16 psid
Fuel Control rpm	0.167 Ng
High Pressure Relief Valve Setting	950-1000 psig
Ng Maximum rpm (Mechanical Topping)	38,250 rpm

5. Free Turbine Speed Controller

A. Description

The free turbine speed controller (Ref. Fig. 5) consists of an electromagnetic torque motor and a variable air bleed



FCU P3 Air Filter
Figure 4

device. The torque motor contains a coil and magnet assembly and an armature. The air bleed device contains a fixed orifice and an air inlet nozzle which, in conjuction with a movable disc shaped flapper at the lower end of the armature, comprises a variable orifice. Flapper displacement from its null position is determined by the polarity and strength of the torque motor magnetic field. Air admitted to the unit through the inlet nozzle is exhausted to the atmosphere in varying amounts dictated by the position of the flapper. The free turbine speed controller is mounted on the engine accessory gearcase and connected by a tube to the Py pressure chamber in the fuel control unit. By controlling Py pressure in the fuel control unit, the free turbine speed controller controls the amount of fuel delivered to the engine and thereby, engine power output.

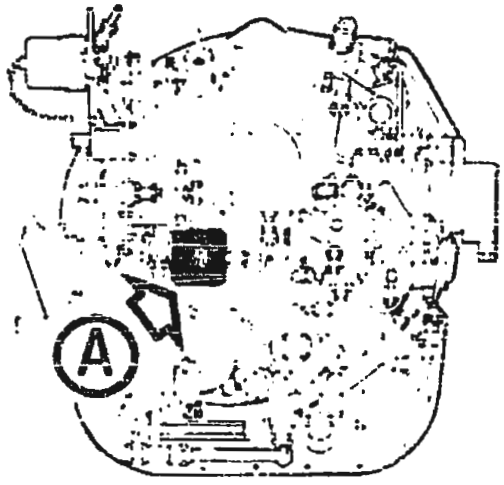
B. Operation

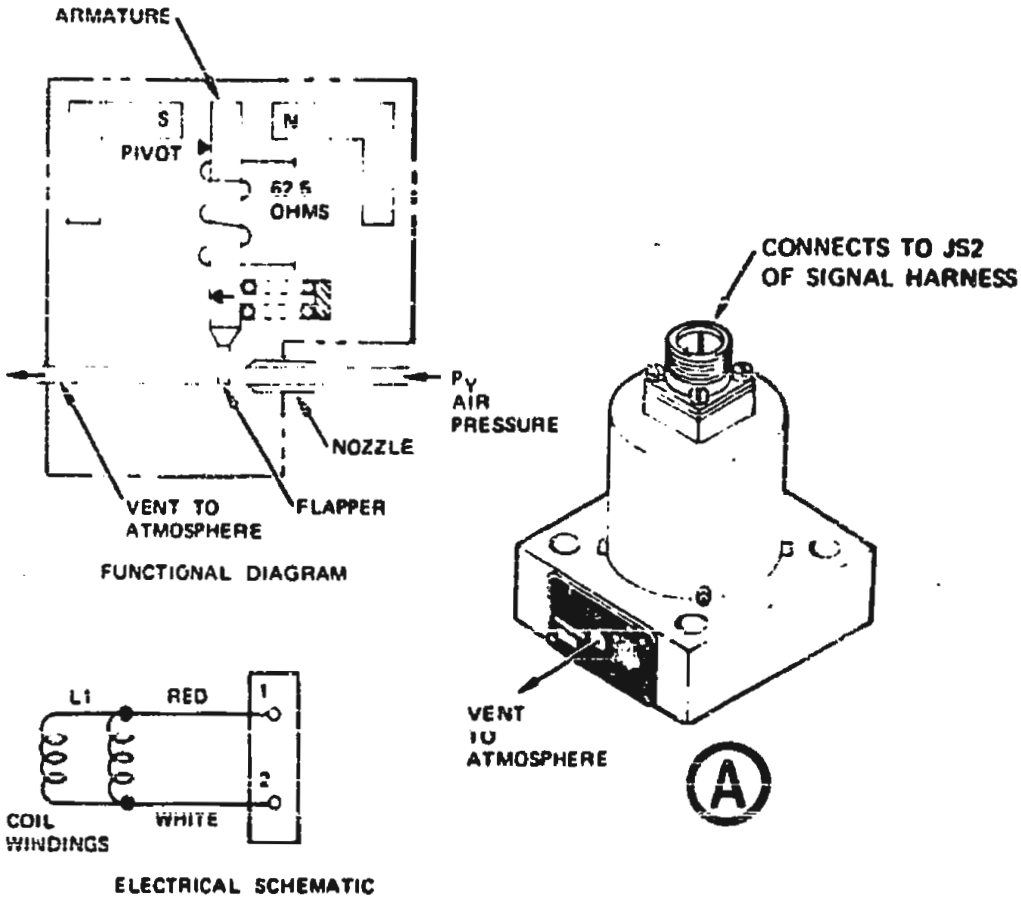
The free turbine speed controller is used in conjunction with the APU electronic control unit to control Py pressure in the fuel control unit and, in turn, the amount of fuel metered to the engine. Current from the electronic control unit, when applied to the torque motor coil, establishes a magnetic field which exerts a torque on the armature stem and displaces the armature flapper from its null point. The amount of flapper displacement depends on the polarity and magnitude of the input current. Depending on the direction of flapper displacement, the amount of air bled from the fuel control unit Py chamber is either increased or decreased. Since Py pressure in the fuel control unit is the controlling parameter for metered fuel flow, increasing Py pressure will increase fuel flow and engine power (to a maximum of 101.6% Ng); decreasing Py pressure will decrease fuel flow and engine power. When current to the controller is reduced to zero, the spring rate inherent in the design of the flapper returns it to the null position and reduces Py pressure to the minimum fuel flow condition. A loss of signal input to the controller or failure of the torque
R motor coil will thus drive the APU to idle speed (63 percent
R Ng).

6. Oil-To-Fuel Heater

A. Description

The oil-to-fuel heater (Ref. Fig. 6) mounted on the APU engine accessory gearcase is essentially a heat transferring unit in which heated engine oil is used to maintain APU inlet fuel temperature at a regulated temperature of 70 to 90 degrees F (21 to 32 degrees C). The heater consists of





M1-0100-49-393

Free Turbine Speed Controller
Figure 5

an integral heat exchanger and housing containing a thermostatically controlled oil bypass valve. Fuel is admitted to the heat exchanger core from the APU fuel inlet hose and makes two passes through the core before flowing out of the unit to the fuel pump and filter assembly. The passage of heated engine oil through the heat exchanger core is controlled by the thermostat operated bypass valve before flowing out of the unit to the engine oil-to-air heat exchanger (Ref. 49-91-01). The thermostat is sensitive to the temperature of fuel at the heater fuel outlet port and contains a Vernatherm element which, when heated, expands to regulate the opening and closing of the oil bypass valve.

B. Operation

The amount of heated oil that is allowed to flow through the heat exchanger core is controlled by a spring loaded oil bypass valve. Valve position is determined by a Vernatherm element in the thermostat which when heated expands to open the valve. When the element contracts, the valve is returned toward its closed position by the valve return spring. The operating position of the valve is thus regulated as required to maintain fuel temperature at the value noted above.

C 7. Deleted

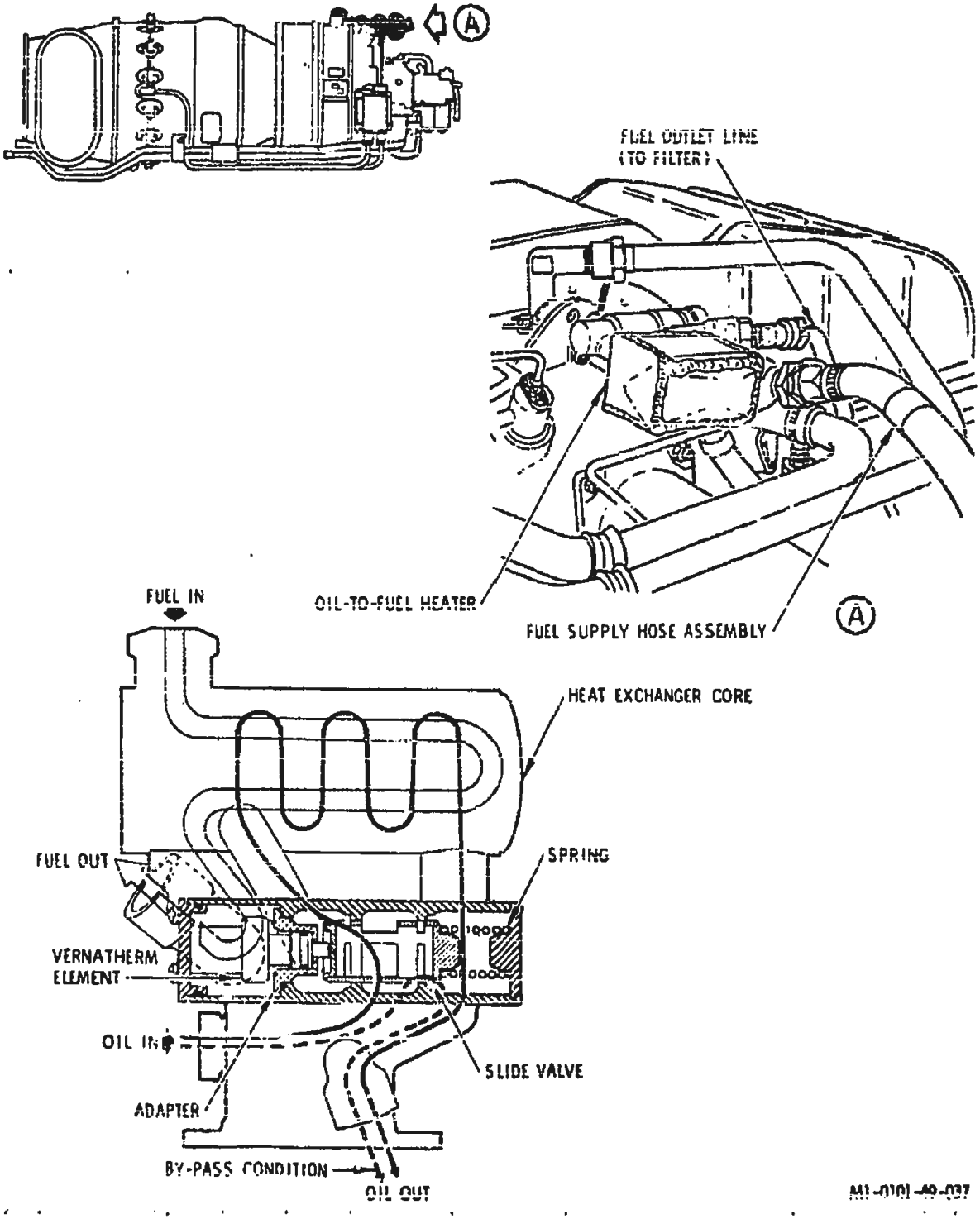
8. Compressor Inlet Air Temperature Sensor

A. Description

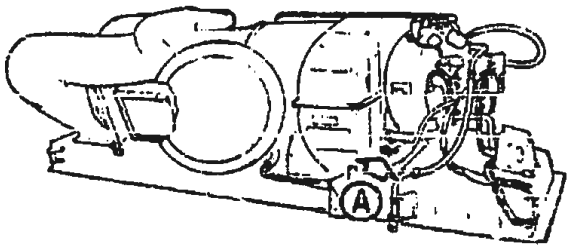
The compressor inlet air temperature sensor (Ref. Fig. 8) is a metal probe containing a sealed heat sensitive thermister. The sensor is mounted in the lower right forward side of the engine air plenum where it monitors the temperature of the air entering the engine.

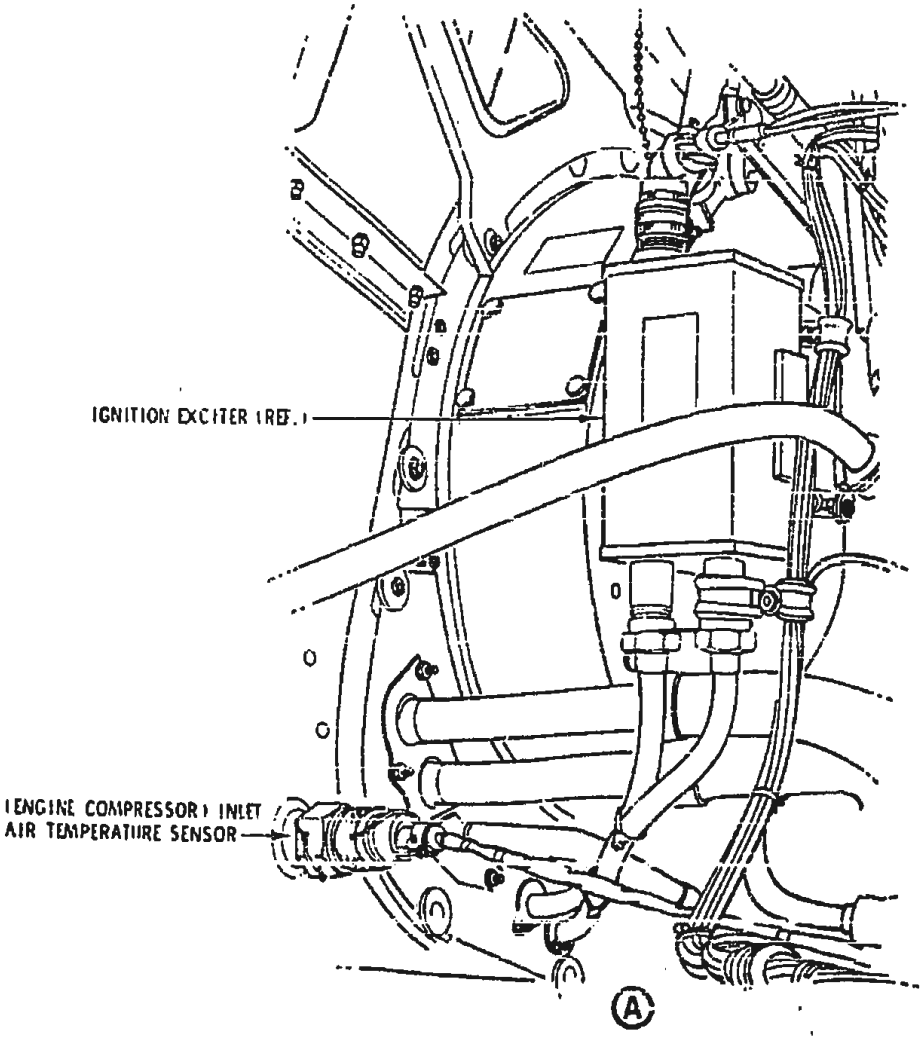
B. Operation

Variations in compressor inlet air temperature cause changes in the thermister resistance. Changes in current through the thermister are reflected as signal inputs to the electronic control unit (ECU). The ECU signals to control load compressor inlet guide vane position and engine fuel flow when operating in the Ng trim limiting range. The inlet temperature sensor is used as an input to the electronic control unit to schedule inlet guide vane position and limit engine speed.



Oil-To-Fuel Heater
Figure 6





M1-0102-49-000

Compressor Inlet Air Temperature Sensor
Figure 8

9. Free_Turbine_Speed_Sensors

A. Description and Operation

R Two free turbine speed sensors are installed in the load hardware gearbox (Ref. Fig. 9). Each sensor is an identical unit, consisting of a permanent magnet and a coil encased in a stainless steel housing. When installed, the sensor magnets are in close proximity to a slotted wheel on the free turbine output shaft. Rotation of the shaft (and wheel) magnetically induces a current in the sensors that is directly proportional to the free turbine shaft rpm. Signals from both sensors are applied to the electronic control unit.

The upper sensor is referred to as the NfB sensor and the lower one, the NfA sensor. The electronic control unit utilizes the NfA signal to produce an engine speed controller input signal that will vary engine power output as required to maintain the free turbine at 33,000 rpm.

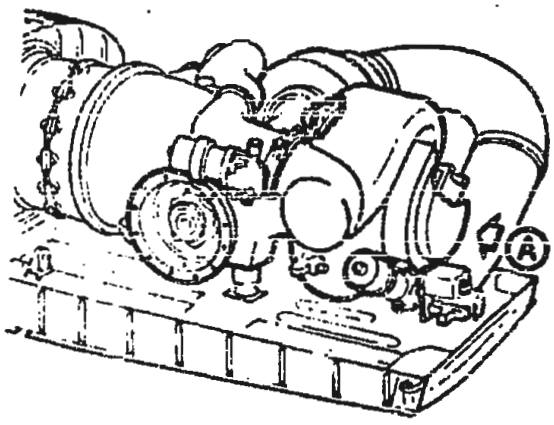
The NfB sensor is primarily a free turbine overspeed protection device. A signal indicating a turbine overspeed condition is processed by the electronic control unit to shut down the APU and trip the overspeed N2 flag on the APU control panel. The NfB sensor signal is also used by the electronic control unit to control the DONT LOAD light.

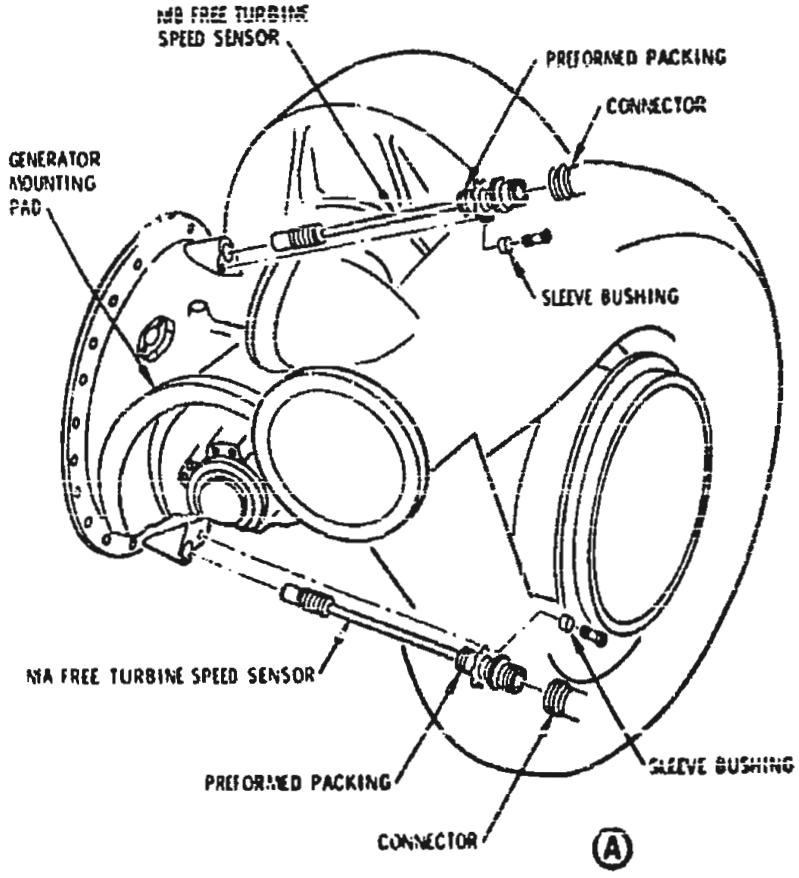
Ordinarily, both NfA and NfB will provide overspeed protection, the NfA sensor serving as a backup for the NfB sensor. An automatic shutdown of the APU is incurred if the NfA sensor signal is not present in the ECU during an APU start or is lost during APU operation.

10. Flow_Divider_and_Dump_Valve

A. Description

R The flow divider and dump valve (Ref. Fig. 10) is flange mounted to the number 8 fuel manifold adapter. This unit
R serves two functions: it divides metered fuel flow between the primary and secondary fuel manifolds during engine start and operation, and it dumps residual fuel from the manifolds into a line to the drip tank when the engine is shut down. Fuel flow through the unit is controlled by a plunger and valve assembly consisting of a center-bored plunger containing a snap-ring retained transfer valve which is spring-loaded against an insert at the opposite end of the plunger. Transfer valve movement within the plunger is limited by a portion of the insert which projects into the plunger bore. Both transfer valve and plunger are





Free Turbine Speed Sensors
Figure 9

spring-loaded against a spring housing bolted to the body of the unit. The forces exerted by the two springs in opposing inlet fuel pressure determine the position attained by the transfer valve and plunger. Transfer valve and plunger position, in turn, control the porting of fuel to two passages in the body to outlet ports in the body mounting flange and through a slotted passage in the plunger surface to the dump valve port in the plunger spring housing.

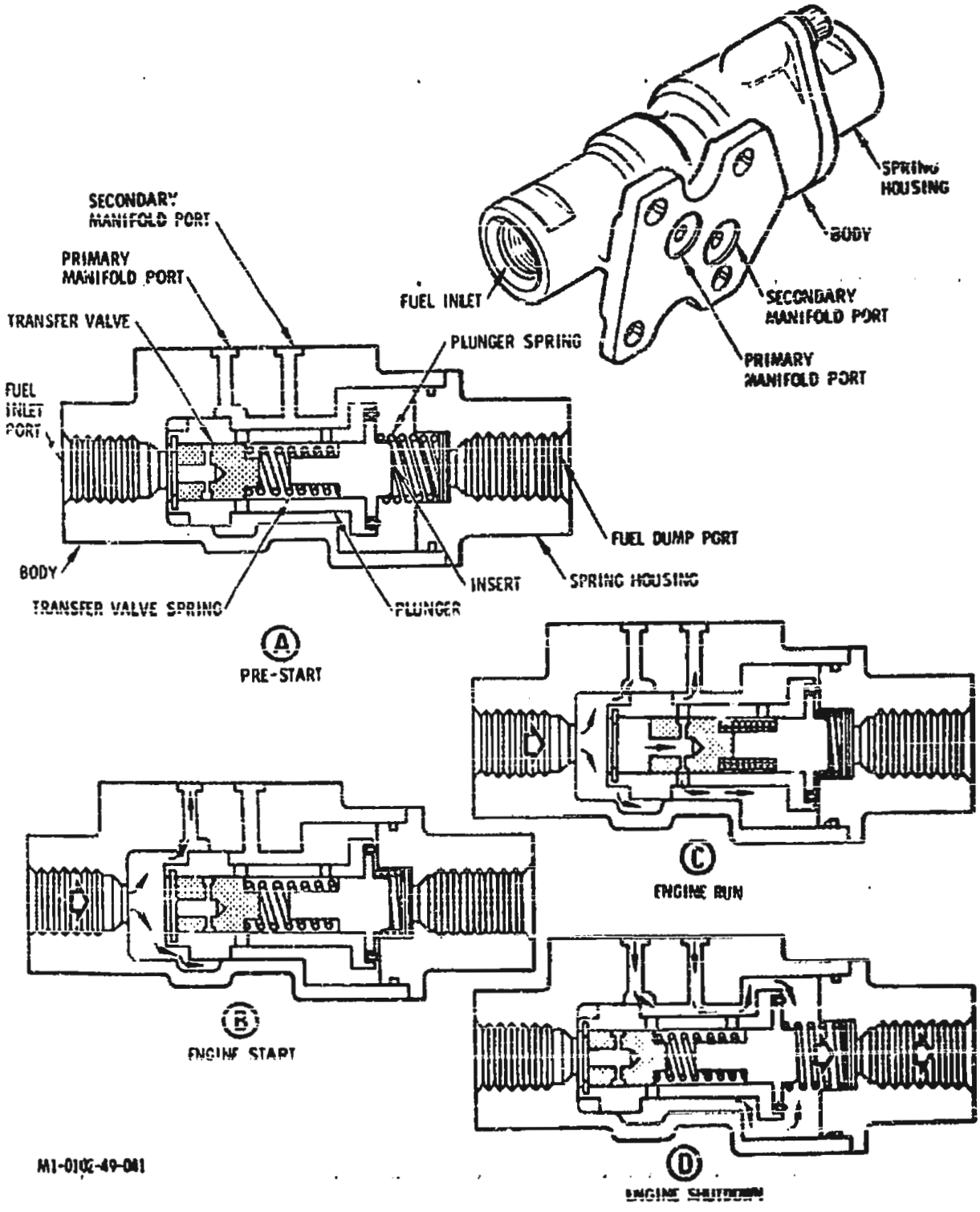
B. Operation

Metered fuel from the fuel control unit is admitted to the flow divider and dump valve through a port in the valve body opposite the plunger spring housing (Ref. Fig. 10). With no fuel pressure at the inlet port (Ref. View A) internal spring forces against the transfer valve and plunger retain the components in a position that closes off the fuel passages to the primary and secondary fuel manifolds and uncovers the fuel dump port. During an APU start (Ref. View B) when fuel pressure at the inlet port reaches 9.3 psig, the spring force between plunger and spring housing is overcome and the plunger and valve assembly moves in a direction that blocks the fuel dump port. Fuel flows through a milled slot in the transfer valve to the primary manifold outlet port. The secondary fuel manifold port remains closed. When inlet fuel pressure rises to 19.5 psig, the transfer valve spring force is overcome and the valve moves into contact with the plunger insert. The secondary fuel manifold port is uncovered and fuel flows to secondary manifold outlet port (Ref. View C) through passages in the transfer valve and plunger that come into alignment. When the engine is shut down (Ref. View D) and inlet fuel pressure drops to zero. The transfer valve moves away from the plunger insert. Fuel flow through the transfer valve and plunger to the secondary fuel manifold port is cut off. The plunger spring moves the plunger and valve assembly away from the fuel dump port and fuel in the secondary fuel manifold flows through a milled slot in the plunger to the fuel dump port. Continued movement of the plunger and transfer valve closes off the fuel inlet port. With the plunger and valve assembly in this position (Ref. View D), fuel drains from the primary fuel manifold through a milled slot in the plunger surface to the fuel dump port.

11. Fuel Nozzle and Manifold Adapters

A. Description and Operation

R Metered fuel from the fuel control unit is injected into the
R engine combustion chamber in a finely atomized spray through seven primary and seven secondary fuel nozzle and adapter



Fuel Divider and Dump Valve
Figure 10

assemblies equally spaced around the circumference of the engine (Ref. Fig. 11). Each nozzle is identical in construction, consisting of a fuel distributor and body, helical spring, strainer element, spring seat, and seat retainer ring. The nozzle assembly is screwed into a spigot section of the adapter that projects through the engine case and combustion chamber liner. The spigot is surrounded by a sheath through which cooling air in the liner is admitted to cool the nozzle and help atomize the fuel. Fuel is sprayed through a hole in the sheath in a direction that produces a tangetial spray of fuel around the combustion chamber.

The 14 fuel nozzle adapters are retained by lockplates and bolts to the engine case and interconnected by 14 pairs of
R parallel fuel transfer tubes that form two dual fuel distribution manifolds, one manifold supplying the primary nozzles and the other, the secondary nozzles.

Primary nozzle and adapter assemblies are identical units and may be interchanged only with another primary unit in the locations shown on Figure 11. Secondary nozzle and adapter assemblies are also identical and may be interchanged only with a secondary unit except for the unit installed at the 6 o'clock position which is configurated to mate with and support the fuel flow divider and dump valve.

12. System Operation

Fuel is supplied to the APU from the No. 2 engine fuel feed line, through the normally open APU emergency fuel shutoff valve, when the APU MASTER POWER SWITCH is placed in the ON position and the APU primary emergency fuel shutoff valve opens. From the secondary fuel shutoff valve, fuel is routed through a pipe assembly to the forward wall of the APU compartment where it flows through a flexible hose to the APU engine-driven fuel pump.

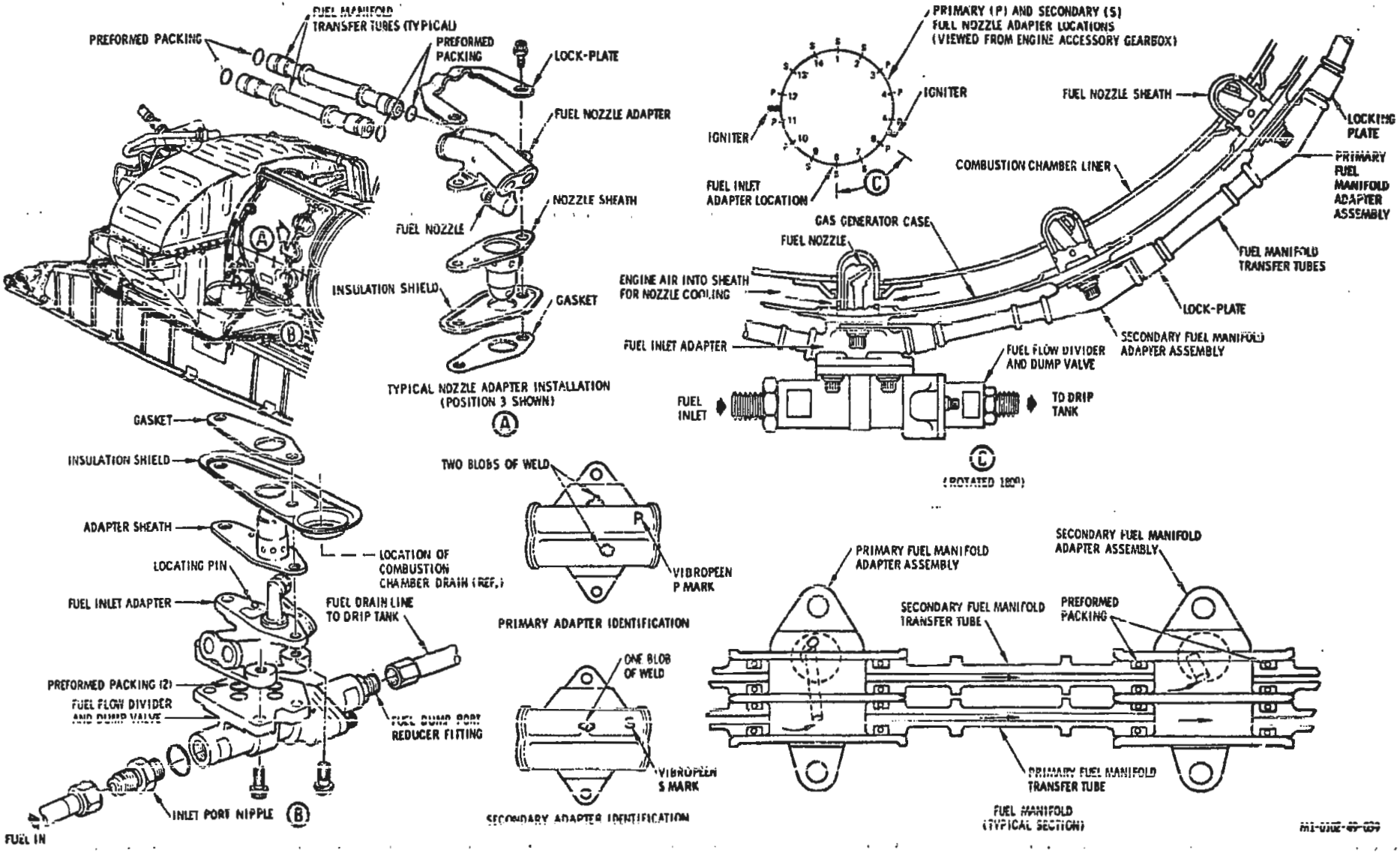
Fuel flow to the engine is regulated by the fuel control unit (FCU) metering valve which is connected by linkage to governor bellows in the pneumatic section of the unit. The position of the metering valve pin and the amount of fuel flowing through the metering valve orifice are determined by the Px and Py pressures acting on the bellows. These pressures are produced by compressor discharge air (P3) which is delivered to the Px and Py sides of the governor bellows through fixed orifices. Essentially, engine power is controlled by varying the amount of air bled from the Py side of the governor bellows. A reduction in Py pressure causes the metering valve to reduce fuel flow to the engine while an increase in Py pressure increases fuel flow. The Py pressure can be varied by controlling the amount of air
R bled through two bleed air orifices. One Py bleed is in the FCU

and is operated by the Ng speed limiting governor which prevents engine speed (Ng) from exceeding the maximum allowable Ng limit. The second Py bleed is a variable orifice located in the free turbine speed controller. The FCU is provided with a manually operated engine power control lever for use in test cell operations. In the aircraft, this lever is locked in the
R maximum speed position (102 percent Ng) and engine power output is controlled by the free turbine speed controller.

Fuel entering the APU engine-driven fuel pump (Ref. Fig. 2) is pre-heated in an oil-to-fuel heater before being filtered by a disposable 10-micron filter. A filter bypass valve in the fuel pump and filter assembly will open and divert unfiltered fuel around the filter element if contamination is severe enough to cause a differential pressure across the filter element of 2.7 to 3.0 psid. Fuel is pressurized by a gear-type fuel pump and directed through internal passages in the automatic fuel shutoff valve and an external line to the fuel control unit. A pressure relief valve in the fuel control unit will bypass fuel back to the pump inlet whenever pump output exceeds 950 psi.

In the fuel control unit (Ref. Fig. 3), fuel under pump output pressure fills the P1 chamber and acts upon one side of a diaphragm in a fuel bypass valve. Fuel in the P1 chamber is metered through a variable orifice in the metering valve to the P2 chamber and the opposite side of the bypass valve diaphragm. The amount of fuel passed through the orifice is determined by the position of a metering pin which, in turn, is positioned by the governor bellows Px-Py differential pressure determined by the free turbine speed controller. The function of the bypass valve is to maintain the P1-P2 differential pressure at a constant value so that the amount of fuel delivered to the engine will be determined only by the size of the metering valve orifice. It does this by regulating P1 chamber pressure, bypassing back to the pump inlet excess fuel not required to maintain a constant P1-P2 pressure.

P2 metered fuel is directed through an external line to the solenoid-operated normally closed fuel shutoff and normally open fuel bypass valves in the automatic fuel shutoff valve assembly. The fuel shutoff valve is opened and the fuel bypass valve is closed simultaneously when energized by 28V dc power from the electronic control unit during the APU start. The fuel shutoff valve is designed to provide a quick positive shutoff of fuel to the engine. The bypass valve provides rapid dump or return of fuel to the pump inlet and prevents pressure surges back into the fuel control unit and bypass valve when the shutoff valve is suddenly closed. A pressurization valve just downstream from the fuel shutoff valve normally opens at approximately 13 psig and allows fuel to flow through an external fuel line to the flow divider and dump valve. As the valve opens, it provides a small amount of pressure build-up against the fuel control



Fuel Nozzle and Adapters
Figure 11

R EFFECTIVITY: ALL
R
0018

bypass valve diaphragm. The pressurization valve maintains the fuel control unit at its minimum operating pressure and provides a positive shutoff of fuel to the nozzles when the solenoid operated fuel shut-off valve is commanded to close.

Fuel is directed to the nozzles by the flow divider and dump valve (Ref. Para. 9). The initial amount of fuel entering the valve is dumped into the drip tank. At 9.3 psig the valve primary poppet moves in a direction that closes the fuel dump port and directs fuel to the primary nozzles. As fuel pressure increases, the secondary poppet opens and fuel is then directed also to the secondary nozzles. This occurs at approximately
R 19.5 psig (or 35 per cent Ng speed).

The Ng speed limiting governor begins to limit fuel flow at the maximum allowable Ng speed. This is accomplished by bleeding off air pressure in the fuel control Py chamber. Reducing Py pressure moves the metering valve pin in a direction that closes off the metering valve orifice which, in turn, limits the maximum amount of fuel being metered to the nozzles.

When the APU is shut down, the fuel shutoff and bypass valve solenoids are deenergized. The fuel shutoff valve closes, abruptly cutting off fuel to the nozzles, and the fuel bypass valve opens to divert fuel from the FCU back to the fuel pump inlet. With the sudden drop of fuel pressure at the fuel shutoff valve outlet, the minimum pressure valve closes and fuel in the fuel manifolds is ported by the flow divider and dump valve to the drip tank.

R NOTE: During the shutdown cycle, the ECU will command the APU to operate at 63 percent Ng for approximately 85 seconds (for engine cooldown and temperature stabilization) before shutting down. In addition, when operating in the load topping regime fuel flow is progressively reduced to prevent Turbine Gas Temperature (TGT) from rising higher than 1050 degrees C. The provision is, in effect, an additional load topping function intended to prevent the damaging affects of high engine temperatures under maximum load conditions. This Ng limiting schedule supplements the Ng trim limit adjustment which normally limits maximum Ng, and the overtemp TGT shutdown function, which will still initiate an overtemp shutdown at 1060 degrees C.

ENGINE-DRIVEN FUEL PUMP - REMOVAL AND INSTALLATION

1. Equipment and Materials

Container, 1-gallon minimum

R Gasket (Ref. Fig. 301)

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

O-rings (Ref. Fig. 401)

2. Referenced Procedures

24-41-00	External Power/Ground Service System - Maintenance Practices
49-31-02	Fuel Control Unit - Removal and Installation
49-31-11	Automatic Fuel Shutoff Valve - Removal and Installation

3. Removal/Installation

A. Removal

(1) Ensure the MASTER POWER switch on the APU CONTROL panel, zone 215, is in the OFF position. Attach a Maintenance-in-Progress tag to the switch.

(2) Open APU access door 319AL.

(3) Place a suitable container under the fuel filter drain (Ref. Fig. 401), remove drain plug and drain system.

(4) Remove the fuel control unit (Ref. 49-31-02).

(5) Remove the automatic fuel shutoff valve (Ref. 49-31-11).

(6) Remove the retaining bolts and washers on the fuel inlet line flange connection (Ref. Fig. 401).

(7) Release the fuel inlet line from the pump and discard the O-ring from the groove around the pump inlet port.

(8) Remove the self-locking nuts and plain washers which secure the fuel pump to the accessory gearbox housing.

(9) Remove the fuel pump assembly from the gearbox and discard the gasket.

B. Installation

(1) Clean the mounting pad on the accessory gearbox housing. Install fuel pump using new gasket.

(2) Clean the mounting face of the fuel pump and lubricate the drive spline with clean engine oil. R

(3) Install the fuel pump over the studs, taking care that the splines engage freely. Do not use force to obtain alignment.

(4) Secure the fuel pump with plain washers and self-locking nuts. Start all nuts on studs prior to tightening and torque nuts 75 to 85 lb in.

(5) Install a new O-ring in the groove around the fuel pump inlet and secure the fuel inlet line with washers and bolts. Torque bolts 25 to 35 lb in. and lockwire.

(6) Install the fuel control unit (Ref. 49-31-02).

(7) Install the automatic fuel shutoff valve (Ref. 49-31-11).

(8) Check the installation by performing the following steps.

(a) Turn on electrical power (Ref. 24-41-00).

(b) On the Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker APU BAT BUS - IGNITION.

CAUTION: CHECK THAT THE NO. 2 ENGINE FUEL SYSTEM IS READY TO BE PRESSURIZED BEFORE OPERATING THE APU TANK VALVE AND PUMP.

(c) On the Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215, place the APU switchlight in the on (latched in) position.

NOTE: The LOW and bar indicators in the APU switchlight and the bar indicator in the APU TANK VALVE indicator will come on if the system is operating.

(d) Remove the Maintenance-in-Progress tag from the MASTER POWER switch on the APU CONTROL panel and place the switch in the ON position.

(e) Check the fuel pump installation for leaks. Repair any leaks before proceeding to next step.

WARNING: THE APU ENGINE AIR INLET DOOR AND THE VENT EJECTOR DOORS WILL OPERATE WHEN THE START AND STOP SWITCHES ARE DEPRESSED. BE SURE ALL PERSONNEL AND EQUIPMENT ARE CLEAR OF THE DOORS.

(f) On the APU CONTROL panel, depress the START switchlight and hold for approximately 2 seconds before releasing. The APU will motor through a hung start cycle lasting approximately 50 seconds.

(g) Observe the fuel pump installation for leaks during motoring.

(h) Press the STOP switch after the APU has stopped motoring.

(i) Place the APU switchlight in the OFF (out) position.

(j) Place the APU MASTER POWER switch in the OFF position.

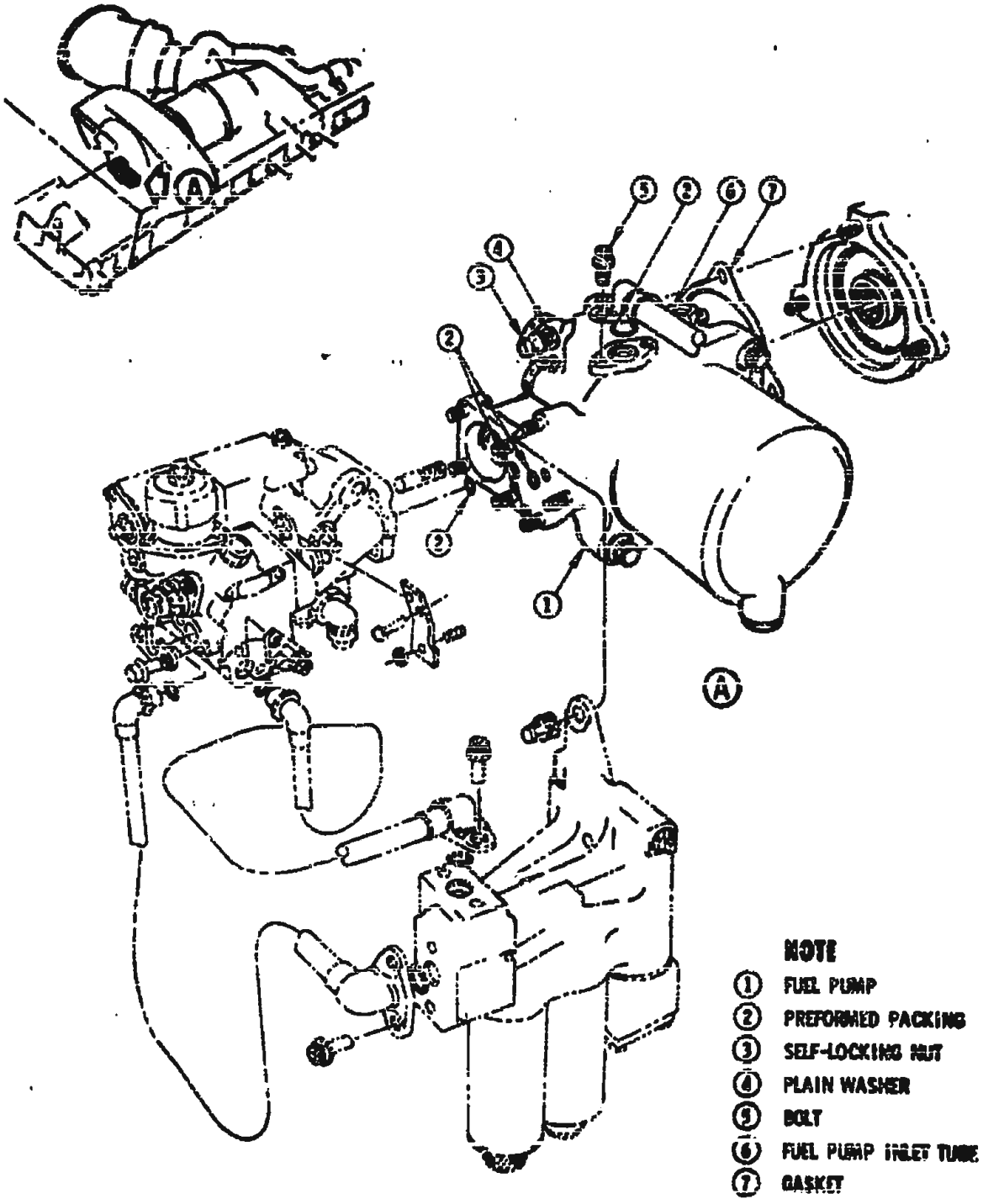
(k) Remove tag and close circuit breaker opened in Step 3B(10)(b).

(l) Turn off electrical power (Ref. 24-41-00).

(m) Drain drip tank after completion of leak check.

(n) Check APU compartment for cleanliness, and then close and secure access door.

(o) Close and secure access door.



R Engine-Driven Fuel Pump - Removal and Installation
R Figure 401

FUEL CONTROL UNIT - REMOVAL AND INSTALLATION

1. Equipment and Materials

Drain pans (As required)

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Lubricant, Dow Corning 44A (or equivalent), Dow Corning Corp., Midland, Mich. 48640

Preformed Packing (Ref. Fig. 401)

2. Referenced Procedures

28-24-00 Engine Fuel Feed System - Adjustment and Test

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

R (1) Disconnect P3 air tube at FCU fitting (Ref. Fig. 401).

R R (2) Loosen Py air tube at free turbine controller, then disconnect Py tube at FCU elbow fitting.

R R (3) Remove four FCU attach nuts and washers and separate FCU from support studs on fuel pump body.

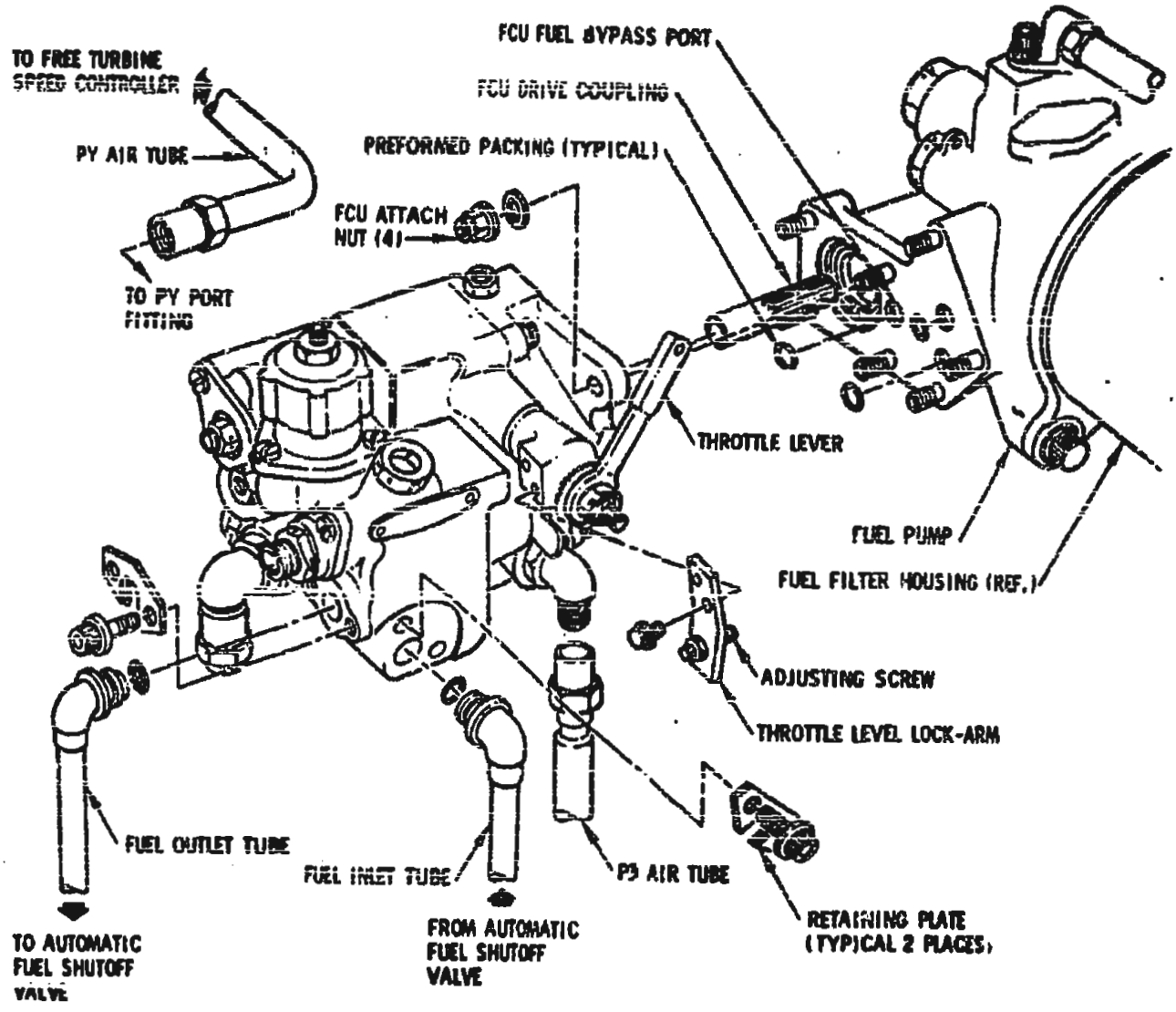
R (4) Remove FCU drive coupling.

R R (5) Remove Py tube elbow fitting and jamnut. Retain for reinstallation on replacement FCU.

R (6) Drain residual fuel from FCU.

R (7) Prepare removed FCU for storage (more than 28 days) by filling the fuel section with clean oil conforming to Spec MIL-L-6081, Grade 1010. Make sure all internal passages are coated with the oil, then drain oil. Remove protective caps and plugs from replacement unit and install on removed unit.

NOTE: If the replacement FCU does not have the throttle lever lock-arm installed, remove it from the FCU being replaced.



Fuel Control Unit - Removal and Installation
Figure 401

B. Installation

(1) Prepare replacement FCU for installation as follows:

(a) Remove protective caps and plugs. (Install on removed unit.)

(b) Drain preservative fluid from fuel control section.

(c) Loosen the throttle lever lock-arm adjustment screw and back it out as required to facilitate installation on new FCU (Ref. Fig. 401).

(d) Install throttle lever lock-arm on throttle lever. Tighten attach bolts and install lock-wire.

(e) With throttle lever held in maximum power position (adjustment screw held securely against stop plate), turn in lock-plate adjusting screw against stop just enough to prevent lever movement. Tighten adjusting screw jamnut and install lock-wire.

(f) Install Py elbow fitting and jamnut in Py port using new pre-formed packing under jamnut. Delay tightening jamnut until FCU is mounted on fuel pump body and elbow fitting is aligned with Py tube.

(2) Lubricate new pre-formed packing with film of Dow Corning 44A lubricant and install in recess around fuel bypass port on fuel pump pad.

(3) Insert FCU drive coupling into end of fuel pump shaft.

CAUTION: BE SURE DRIVE COUPLING PROPERLY ENGAGES FCU DRIVE AND PRE-FORMED PACKING AROUND FUEL BYPASS FORT IS NOT DISLODGED WHEN FCU IS MOUNTED ON FUEL PUMP PAD.

(4) Mount FCU on support studs and install attach washers and nuts. (As nuts are tightened, FCU unit will be drawn into contact with fuel pump pad.)Torque attach nuts 65 to 85 lb in.

(5) Connect P3 air tube. Tighten tube nut to a torque of 135 to 150 lb in. and install lock-wire.

(6) Align Py tube elbow fitting with Py tube and hand tighten tube nut. Tighten elbow jamnut and install lock-wire.

(7) Tighten tube nuts at both ends of Py tube 135 to 150 lb in. and install lock-wire.

(8) Lubricate new pre-formed packing with Dow Corning 44A lubricant and install on FCU inlet and outlet tubes. Insert tubes in FCU ports and install tube retaining plates.

R (9) Tighten FCU fuel inlet and outlet tube retaining plate
R attach screws and install lock-wire.

R (10) Pressurize NO. 2 ENG fuel supply manifold (Ref.
R 28-24-00) and manually open the APU primary emergency
R fuel shutoff valve in zone 317. Check FCU installation
R for fuel leaks.

R (11) Bleed the APU fuel system as follows:

(a) Place suitable size drain pan under APU fuel filter housing and loosen filter housing drain plug. Retighten drain plug and install lock-wire when a steady stream of air-free fuel flows from the housing.

(b) Loosen the cap on the elbow fitting located at the front of the FCU. Tighten the cap and install lock-wire when a steady stream of air-free fuel flows from the fitting.

R (12) Manually close the APU primary emergency fuel shutoff
R valve.

R (13) Operate APU to check out operation of replacement FCU (Ref. 49-00-01).

INLET TEMPERATURE SENSOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

R Lubricant, Dow Corning 44, or equivalent

R Preformed packing

2. Referenced Procedure

R 49-00-01 Airborne Auxiliary Power System - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag circuit breaker APU
R BAT BUS - CONT PWR (S12).

(2) Open access door 319BR.

(3) Remove electrical connector from inlet temperature sensor (Ref. Fig. 401).

CAUTION: ENSURE THAT APU HAS COOLED SUFFICIENTLY FOR SKIN CONTACT.

R HANDLE SENSOR WITH CARE.

(4) Unscrew inlet temperature sensor from air plenum wall.

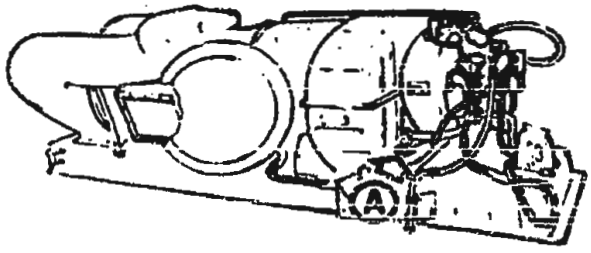
B. Installation

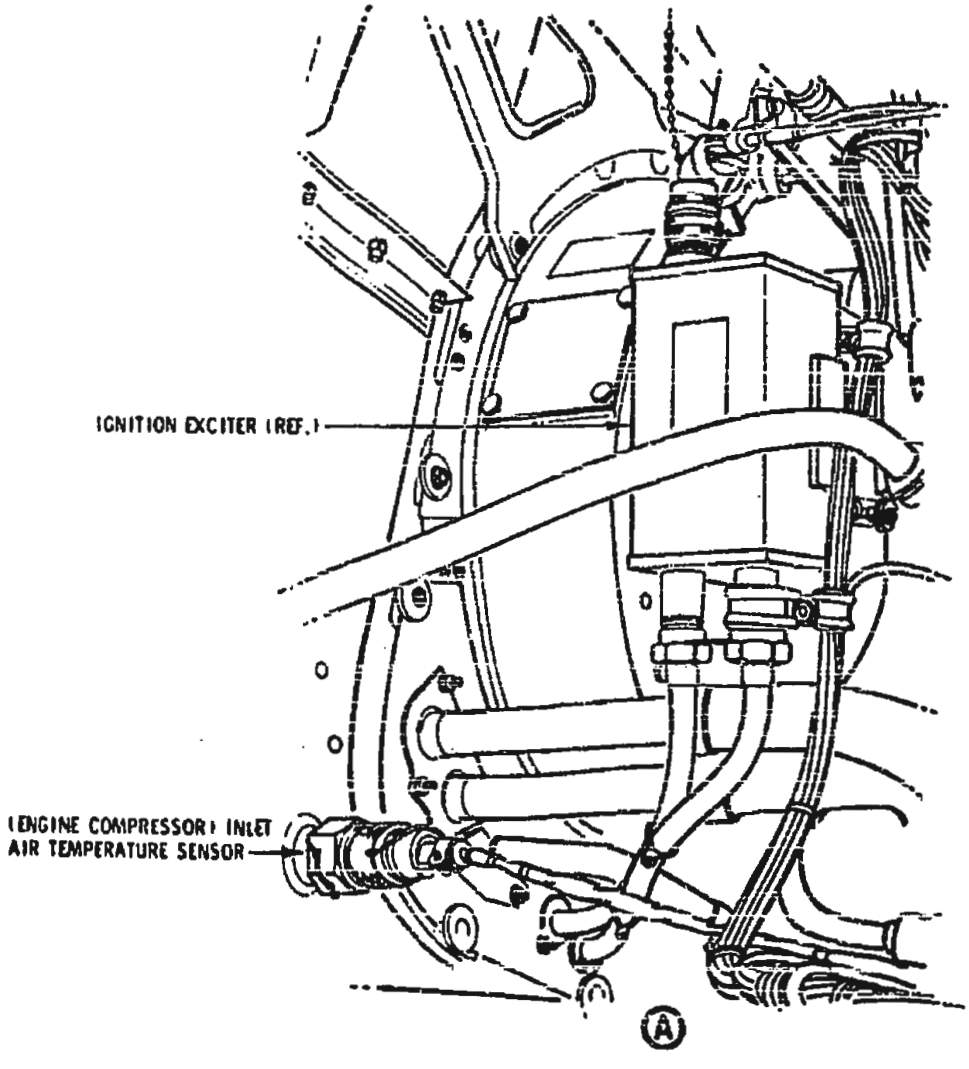
(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

R (2) Lubricate new preformed packing with DC 44 and install
R on sensor probe.

R CAUTION: HANDLE SENSOR WITH CARE. DURING ASSEMBLY,
R R ASSEMBLE HAND-TIGHT. USE OF EXCESSIVE FORCE
R CAN DAMAGE SENSOR.

R (3) Install inlet temperature sensor in air plenum wall.





M1-0102-49-020

R Inlet Temperature Sensor - Removal and Installation
R Figure 401

CAUTION: DO NOT IMPOSE SIDE LOADS ON THE SENSOR RECEPTACLE.

CR (4) Install electrical connector on inlet temperature sensor.

(5) Remove tag and close circuit breaker opened in Step 3A(1).

(6) Operate APU to check function of inlet temperature sensor (Ref. 49-00-01).

(7) Close access door.

FREE TURBINE SPEED CONTROLLER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Gasket (Ref. Fig. 401)

Pre-formed packing (Ref. Fig. 401)

Lock-wire, Fed Spec QQ-W-390, 0.020-and 0.032-inch diameter, or equivalent

2. Removal/Installation

C NOTE: Free Turbine Speed Controller Mounted on Oil Scavenge
C Pump

A. Removal

(1) Ensure that the MASTER POWER switch on the APU CONTROL panel, zone 215, is in the OFF position. Attach a MAINTENANCE IN PROGRESS tag to the switch.

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers B9 through B16.

(3) Open APU access doors 319AL and 319BR.

(4) At free turbine speed controller (Ref. Fig. 401), disconnect signal harness connector JS2.

(5) Disconnect Py air tube installed between free turbine speed controller and fuel control unit.

(6) On APU WITHOUT HAM STD SB49-131,
Remove four controller attach bolts and washers, and separate controller and mounting pad gasket from engine accessory case.

NOTE: If controller is attached to engine pad with tri-wing fillister head machine screws, the machine screws may be replaced with four 12-point machine bolts (Ref. Ham Std SB49-93).

(6) On APU WITH HAM STD SB49-131,
remove nuts and washers, and separate controller and mounting pad gasket from scavange pump housing.

(7) Remove union and pre-formed packing from controller Py pressure port and install protective plug.

(8) Install protective plug in Py air vent port.

B. Installation

(1) Verify that circuit breakers opened in Step 2A(2) are still open and tagged.

CAUTION: BEFORE INSTALLING CONTROLLER, REMOVE PROTECTIVE COVER FROM Py AIR VENT PORT.

(2) Install new pre-formed packing on union (Ref. Fig. 401) and install union in controller Py air port.

NOTE: To facilitate controller replacement, tri-wing fillister head controller attach screws, if used, may be replaced with 12-point machine bolts P/N 69331-4-23, or equivalent, (Ref. Ham Std SB49-93).

(3) Lubricate threads of controller attach bolts with petrolatum graphite.

(4) On APU WITHOUT HAM STD SB49-131,
Place new gasket between controller and mounting pad and secure controller to engine using four bolts and washers. Tighten attach bolts to a torque of 65 to 85 lb in. higher than the screw installation torque (3.5 to 30 lb in.) and install 0.032-inch diameter lock-wire.

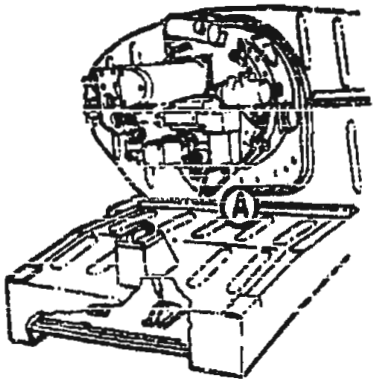
(4) On APU WITH HAM STD SB49-131,
place new gasket between controller and mounting pad. Orient controller so that vent hole is at six o'clock position with controller installed. Torque attaching nuts to 65 to 85 pound-inches. Secure controller using 0.032 inch diameter lockwire.

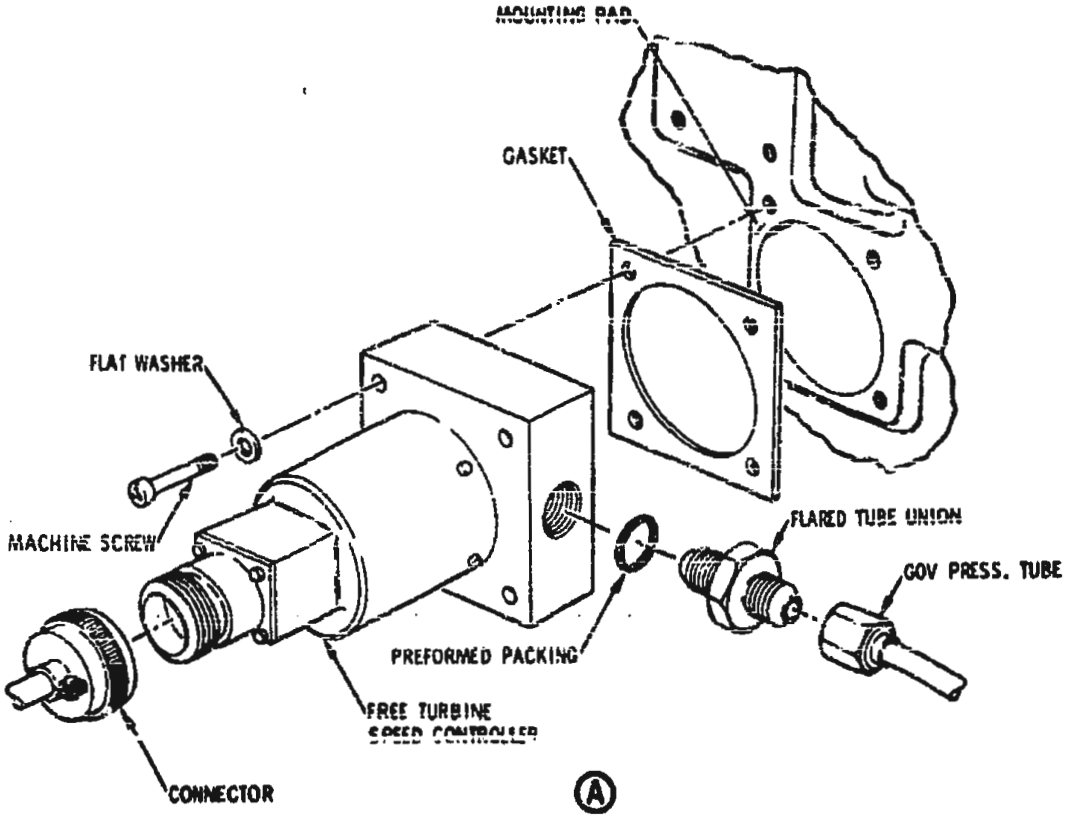
(5) Connect Py air tube. Torque tube nut 135 to 150 lb in. and add 0.032-inch diameter lock-wire.

(6) Attach signal harness connector J52. Tighten connector plug finger-tight. CR

(7) Close APU compartment access doors and rotate fluid scupper aft against door.

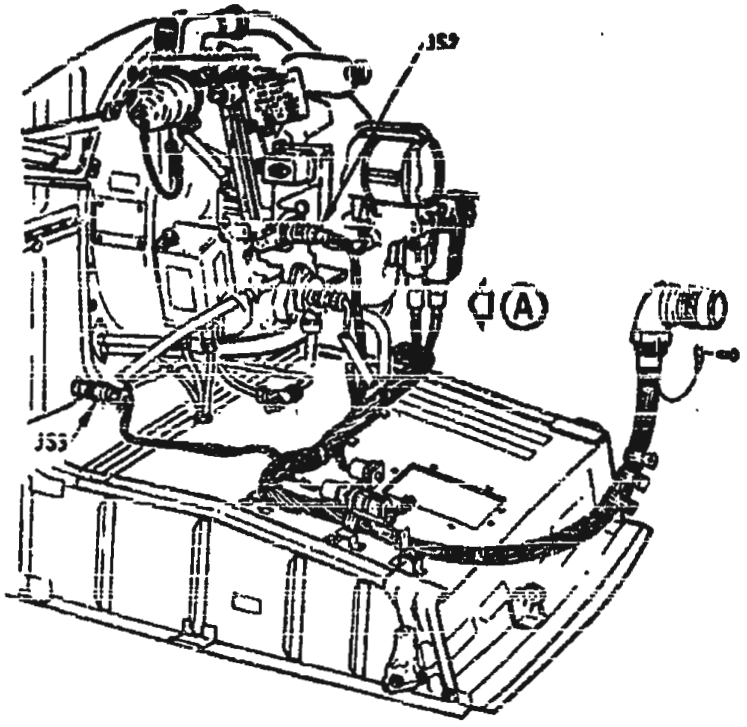
(8) On FE/SO aft circuit breaker panel CB3, zone 215, remove tags and close circuit breakers B9 thru B17.

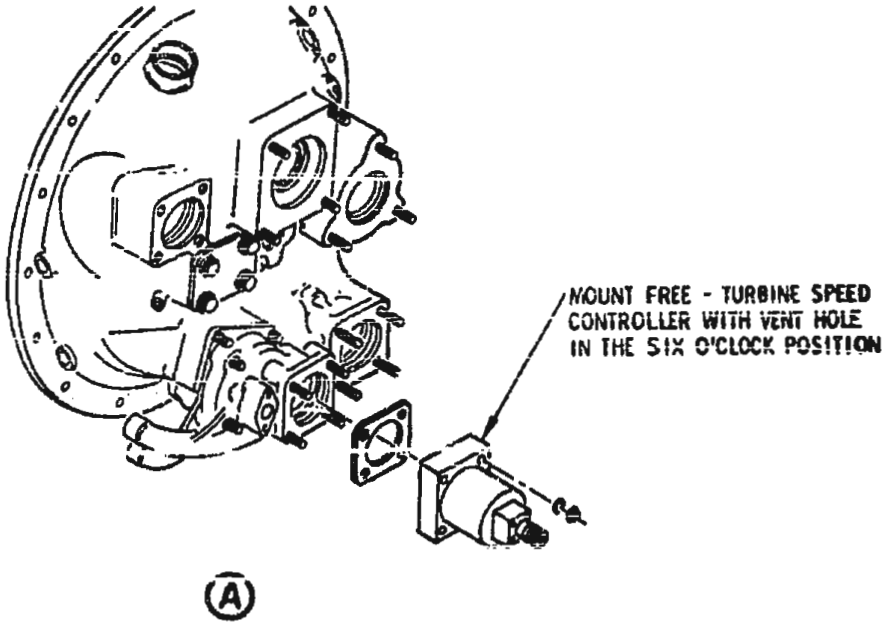




HH 8750
M1-0101-49-132

Free Turbine Speed Controller - Removal and Installation
Figure 401 (Sheet 1)





MI-C000-49-025

Free Turbine Speed Controller - Removal and Installation
Figure 401 (Sheet 2)

(9) Remove MAINTENANCE-IN-PROGRESS tag at APU CONTROL panel.

(10) Operate APU to verify operation of new free turbine speed controller.

CR SENSOR JUMPER HARNESS INSTALLATION - MAINTENANCE PRACTICES

C 1. General

C A. The jumper harness can be used to jumper either NFB (upper C speed sensor) or NFA (lower speed sensor).

C (1) NFA sensor problems cause the APU to shutdown at 55% C during start with overspeed annunciation.

C (2) NFB sensor problems cause the APU to shutdown with an C actual overspeed during start with the "don't load" C light remaining on.

C B. A pair of connectors in the lead from JS14 to JS1 mounted on C a bracket are added to the left side of the APU platform aft C of the inlet plenum (Ref. Fig. 201) in order to provide a C quick troubleshooting break in the NFB circuit, to allow a C continuity check of the NFB transducer, and to provide a C more accessible location to use the jumper lead assembly C when required (Ref. Fig. 202).

C C. Anytime a jumper harness is installed, MCIMD and MCIEE must C be notified so the sensor replacement can be scheduled.

C 2. Equipment and Materials

C Jumper Harness 49-50-01-0018

C Referenced Procedure 49-31-06, Speed Sensor R&I

C 3. Removal/Installation

C A. Installation

C (1) Ensure Master Power Switch on the APU control panel is C in OFF position.

C (2) On Flight Engineer's circuit breaker panel, CB3, open C and tag APU power circuit breakers B9 through B16.

C (3) Open left APU compartment access door.

C (4) Remove connector from inoperative speed sensor.

C NOTE: NFB connector JS14 is not easily accessible; use C JS14A and JS14B (Ref. Fig. 201) for connecting C into NFB.

CR (5) Connect long lead of jumper harness to removed
CR connector (JS11 for NFA or JS14B for NFB).

CR (6) Remove connector from operative NF speed sensor.

CR (7) Connect short section of jumper harness to the
CR operative speed sensor and its connector (NFA sensor to
CR JS11 for NFA or JS14A to JS14B for NFB).

CR (8) Close APU compartment access door.

CR (9) Reset circuit breakers opened in Step (2).

CR (10) Check APU starts normally.

CR (11) Notify MCIMD and MCIEE of jumper harness installation.

CR B. Removal

CR (1) Replace defective speed sensor (Ref. 49-31-06 R&I).

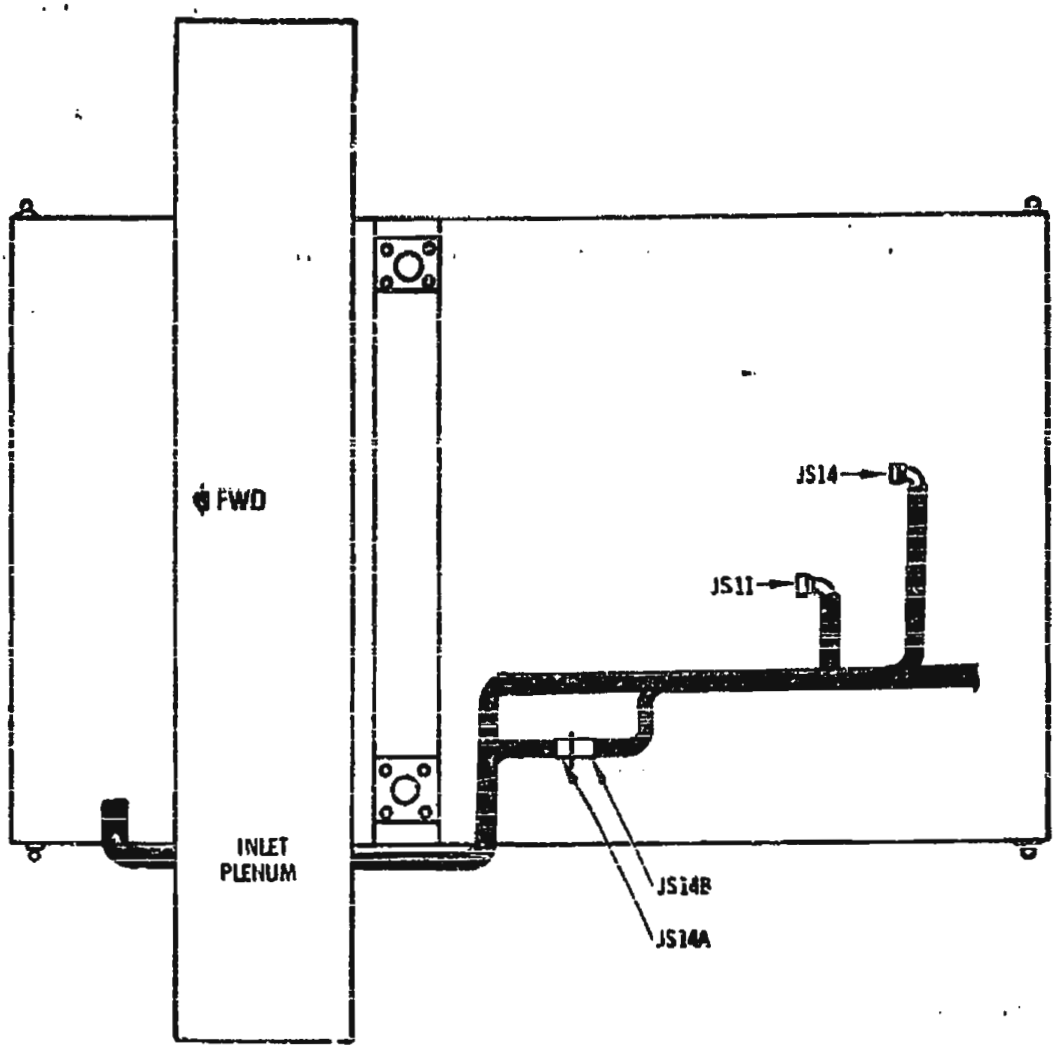
CR (2) Remove jumper harness from APU.

CR (3) Install connectors to speed sensors. Ensure JS14A and
CR JS14B are connected (Ref. Fig. 201).

CR (4) Check APU starts normally.

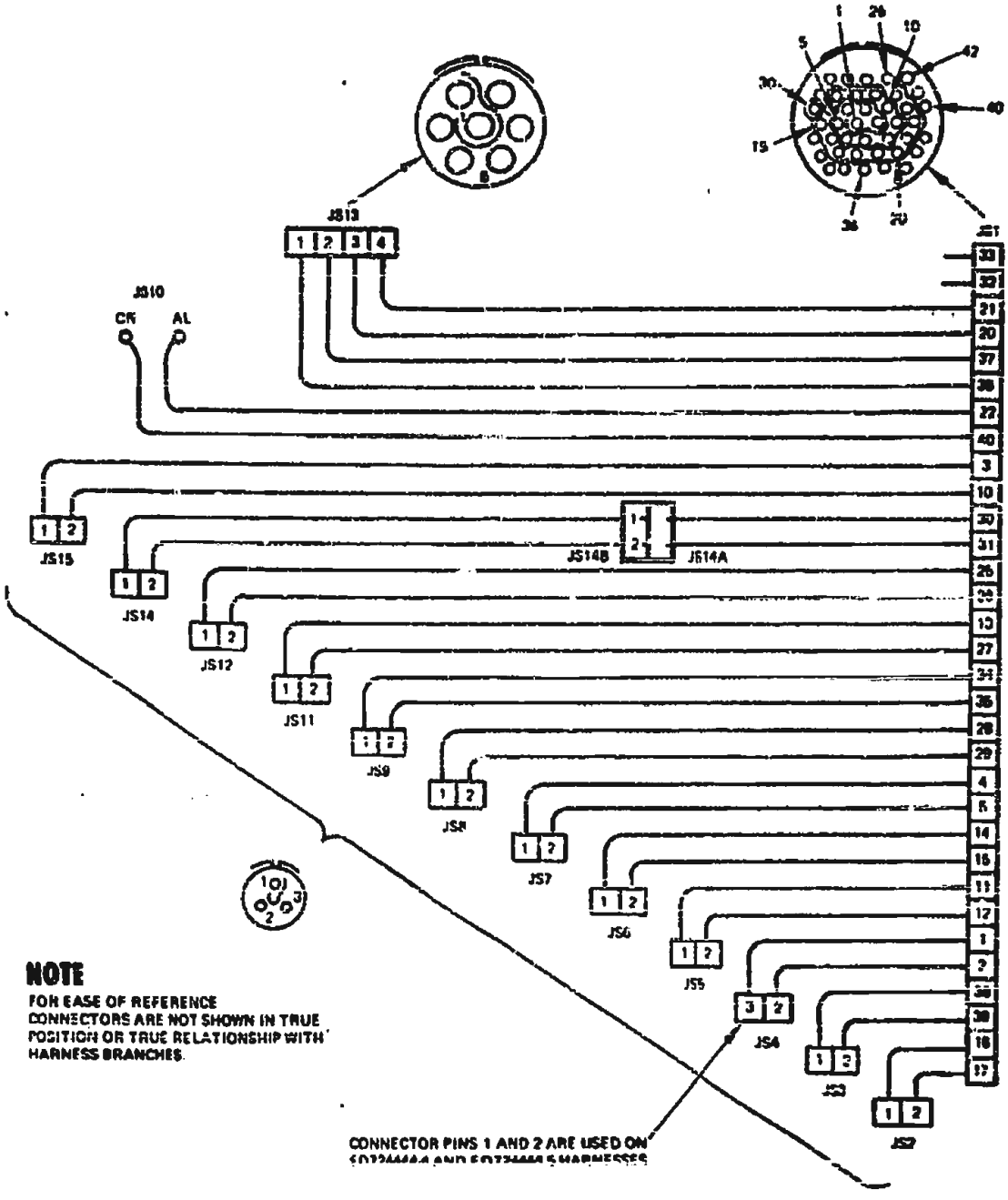
CR (5) Notify MCIMD and MCIEE that jumper harness has been
CR removed.

CR (6) Return removed jumper to station who had installed it.



M1-0000-49-920

Figure 201



M1-0020-00-051

CR
CR

Signal Harness Wiring/Connector Pin Arrangement
Figure 202

R
R
001B

EFFECTIVITY: ALL

FREE TURBINE SPEED SENSOR (BOTTOM) - REMOVAL AND INSTALLATION

1. General

Two free turbine speed spensors are inserted into the compressor gearbox housing at locations shown on Fig. 401. The lower (NfA) sensor can be replaced with the APU installed. Replacement of the upper (NfB) sensor, however, will require lowering of the APU as access to this sensor is too restricted with the APU installed.

2. Referenced Procedure

49-00-01 Auxiliary Power Unit (QEC) - Removal and Installation

3. Equipment and Materials

Preformed Packing (Ref. Fig. 401)

Lubricant, Dow Corning 44, or equivalent

4. Removal/Installation

A. Removal

NOTE: If upper (NfB) sensor is being replaced, lower APU out of APU compartment (Ref. 49-00-01) and proceed with Step 4A(3). If lower (NfA) sensor is being replaced, proceed with Step 4A(1).

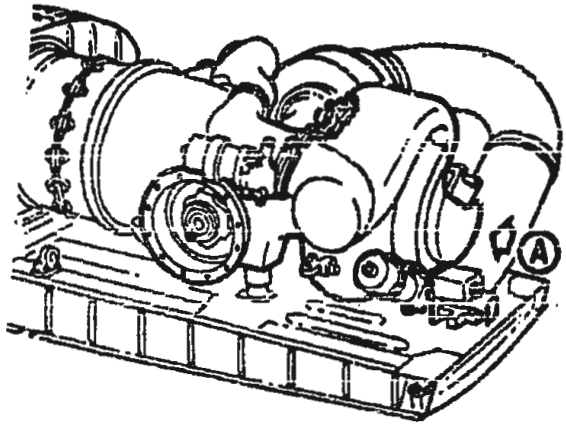
(1) Ensure that the MASTER POWER switch on the APU CONTROL panel is in OFF position. Attach Maintenance-in-Progress tag to switch.

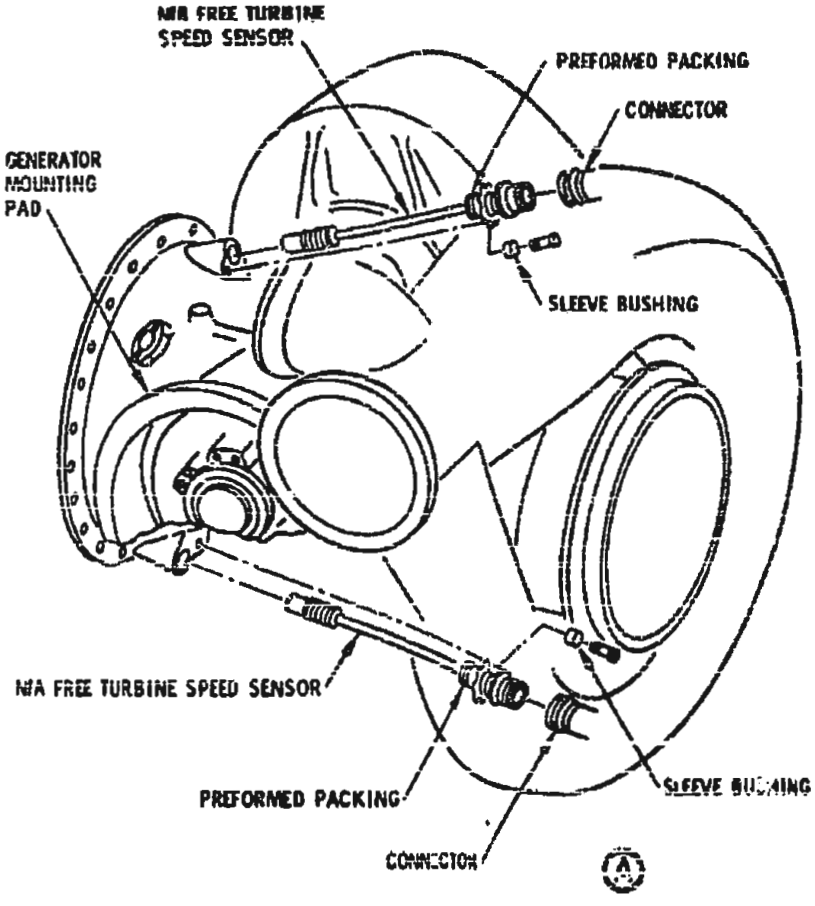
(2) On Flight Engineer/Second Officers aft circuit breaker panel CB5, zone 215, open and tag APU POWER circuit breaker B9 through B16.

(3) Open APU compartment access doors.

(4) Disconnect applicable signal harness connector (JS-11 or JS-14).

(5) Remove sensor adjustment lockscrew and bushing (Ref. Fig. 401).





M1-0101-49-033

R Free Turbine Speed Sensors - Removal and Installation
R Figure 401

EFFECTIVITY: ALL

0018

(6) Unscrew the free turbine speed sensor by hand.

(7) Remove and discard preformed packing installed just below serrated collar.

B. Installation

(1) Apply a thin film of Dow Corning 44, or equivalent, lubricant to preformed packing (Ref. Fig. 401).

(2) Install preformed packing on sensor just below the serrated collar.

(3) Carefully screw sensor into the compressor gearbox housing, by hand, until the sensor just touches the exciter wheel.

(4) Note the position of the serrations on the sensor collar in relation to the lockscrew hole. Back the free turbine speed sensor out six to eight serrations (approximately 310 degrees) and align serration with lockscrew hole.

(5) Install bushing and lockscrew. Be certain that bushing is seated in serrated area of collar, then tighten lockscrew 20 to 30 lb in. and add lock-wire.

CR (6) Attach signal harness connector.

(7) If NfB (upper sensor) was replaced, reinstall APU in APU compartment (Ref. 49-00-01).

(8) Close and secure APU access doors.

(9) If NfA (lower sensor) was replaced, remove tags and close circuit breakers opened in Step 4A(2).

(10) Remove Maintenance-in-Progress tag from MASTER POWER switch.

FUEL FILTER ELEMENT - REMOVAL AND INSTALLATION

1. Equipment and Materials

Container, 1 gallon minimum

Lock-wire, Fed Spec QQ-W-390, 032 diameter or equivalent

2. Referenced Procedure

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On the Flight Engineer/Second Officers APU CONTROL panel, zone 215, ensure the MASTER POWER switch is in the OFF position. Attach a Maintenance-in-Progress tag to the switch.

(2) Open APU access door 319AL.

WARNING: MAKE CERTAIN THE APU HAS COOLED SUFFICIENTLY TO PERMIT SAFE SKIN CONTACT.

(3) Place a suitable container under the fuel filter drain (Ref. Fig. 401), remove drain plug and drain fuel system.

(4) Remove the two bolts and washers retaining the fuel filter cover on the fuel pump housing.

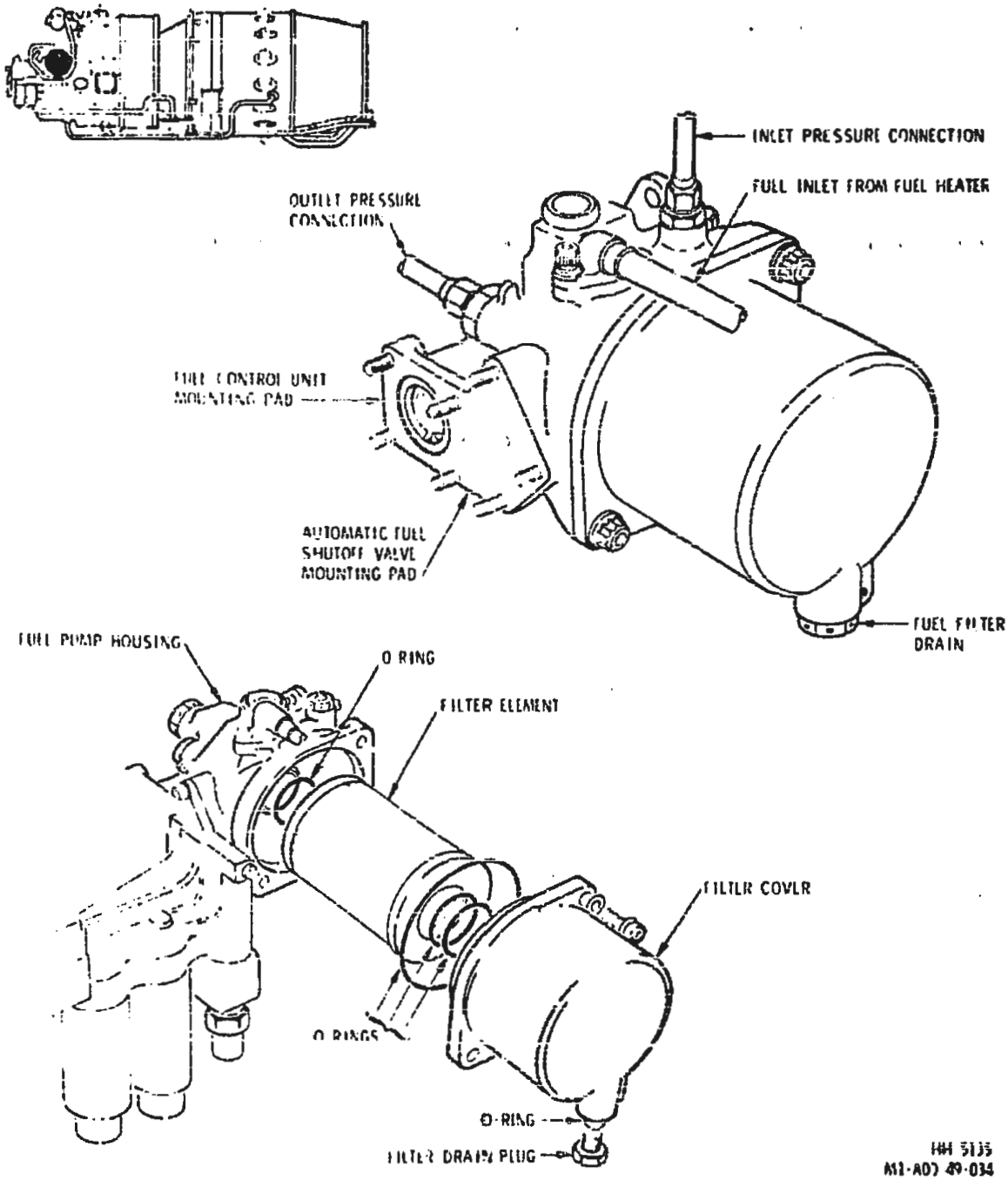
(5) Withdraw the fuel filter cover and remove the fuel filter element from inside the filter cover.

(6) Remove and discard the two O-rings on the internal locating boss in the cover, and one O-ring from groove in cover flange.

(7) Remove and discard the O-ring on the filter element locating boss in the fuel pump housing.

B. Installation

(1) Clean the mating faces of the fuel pump housing and fuel filter cover.



APU Fuel Filter Element - Removal and Installation
Figure 401

(2) Install a new O-ring on the filter locating boss in the fuel pump housing.

(3) Install two new O-rings on the internal locating boss in the filter cover.

(4) Install a new O-ring in the groove in the face of the filter cover.

(5) Position a clean filter element on the internal locating boss in the filter cover.

(6) Install filter element and cover on the fuel pump. Secure with two bolts and plain washers. Torque bolts 25 to 35 lb in and lockwire.

(7) Install a new O-ring on the fuel filter drain plug and install the plug in the filter cover. Torque plug 40 to 65 lb in. and lock-wire.

(8) Remove the Maintenance-in-Progress tag from the MASTER POWER switch.

R (9) Perform a wet motoring cycle (Ref. 49-00-01) and inspect the installation for leaks after the APU fuel pump and tank valve have been energized and again at the completion of the cycle.

(10) Check APU area for cleanliness.

(11) Close and secure the access door.

OIL-TO-FUEL HEAT EXCHANGER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Preformed packing (Ref. Fig. 401)

Drain pan

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

24-41-00	External Power/Ground Service System - Maintenance Practices
49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test
49-21-01	Auxiliary Power Unit (APU) Assembly - Servicing

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breakers APU BAT BUS-PRIM (S7) and CONT PWR (S12). R

(2) Open access doors 319AL and 319BR.

WARNING: ENSURE THAT APU HAS COOLED SUFFICIENTLY FOR SKIN CONTACT.

(3) Place drain pan beneath fuel filter, remove drain plug and drain fuel (Ref. 49-21-01).

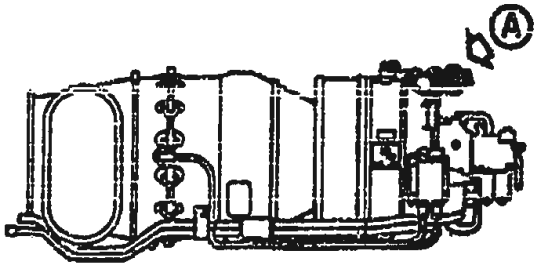
(4) Disconnect fuel and oil lines from oil-to-fuel heat exchanger (Ref. Fig. 401).

(5) Remove nuts and washers attaching heat exchanger to accessory gearbox housing.

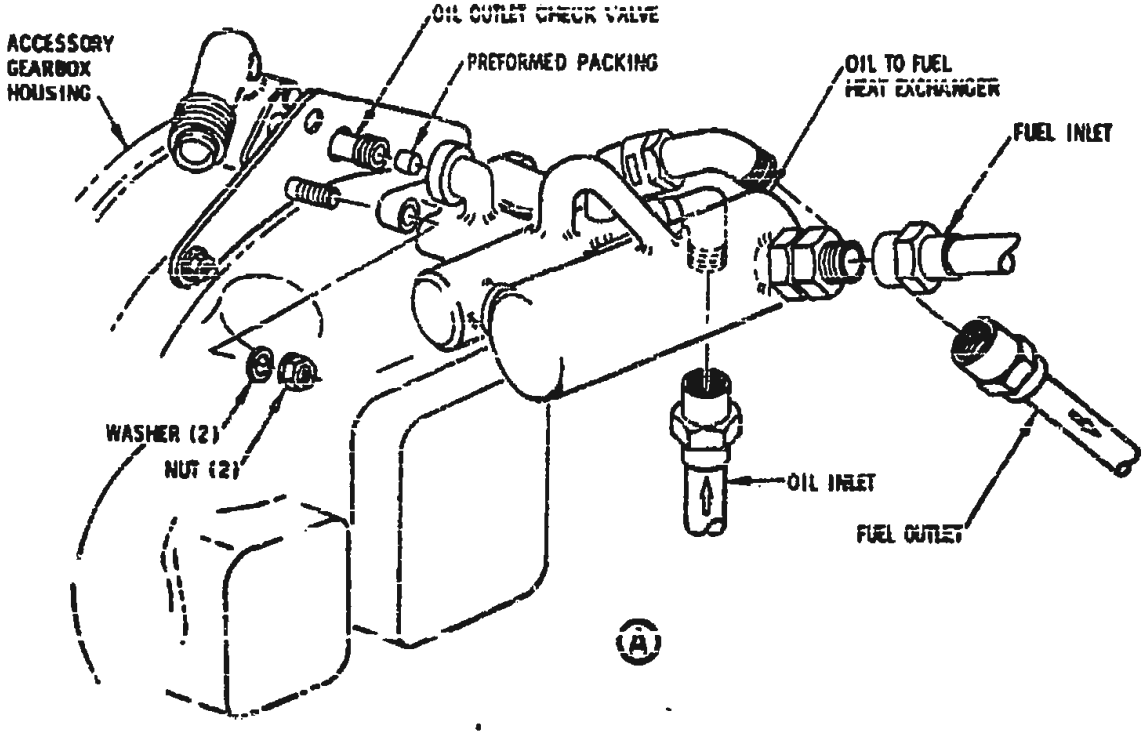
(6) Remove heat exchanger and discard preformed packing.

CAUTION: AVOID SPILLING OIL CONTAINED IN HEAT EXCHANGER.

B. Installation



APU ENGINE
SIDE VIEW



HA 0014
M1-0100-49-023

R R Oil-to-Fuel Heat Exchanger - Removal and Installation
Figure 401

(1) Install new preformed packing on oil outlet check valve (Ref. Fig. 401).

(2) Mate oil-to-fuel heat exchanger to oil outlet check valve and attach exchanger to accessory gearbox housing.

(3) Torque nuts 20 to 30 lb in.

(4) Connect fuel and oil lines to heat exchanger.

(5) Torque fuel and oil line coupling nuts 450 to 500 lb in. and lock-wire nuts.

(6) Install fuel filter drain plug and lock-wire.

(7) Replenish APU oil (Ref. 49-21-01).

(8) Remove tags and close circuit breakers opened in Step 3A(1).

(9) Turn on electrical power (Ref. 24-41-00).

(10) On Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215, depress APU tank pump switchlight and check exchanger fuel lines for leaks.

R (11) Operate APU and check for oil leaks (Ref. 49-00-01).

R (12) Shut down APU (Ref. 49-00-01) and close access doors.

AUTOMATIC FUEL SHUTOFF VALVE - REMOVAL AND INSTALLATION

1. Equipment and Materials

Container, 1 quart minimum

Lock-wire, Fed Spec QQ-W-390, 0.032 diameter, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.020 diameter, or equivalent

2. Referenced Procedures

	24-41-00	External Power/Ground Service System - Maintenance Practices
R	49-31-02	Fuel Control Unit - Removal and Installation

3. Removal/Installation

A. Removal

(1) Ensure the MASTER POWER switch on the APU CONTROL panel (zone 215) is in the OFF position. Attach a Maintenance-in-Progress tag to the switch.

(2) Open APU access door 319AL.

(3) Place a suitable container under the automatic fuel shutoff valve, disconnect the fuel outlet to manifold line (Ref. Fig. 401) and drain the fuel from the valve.

(4) Disconnect and tag the solenoid valve electrical connectors.

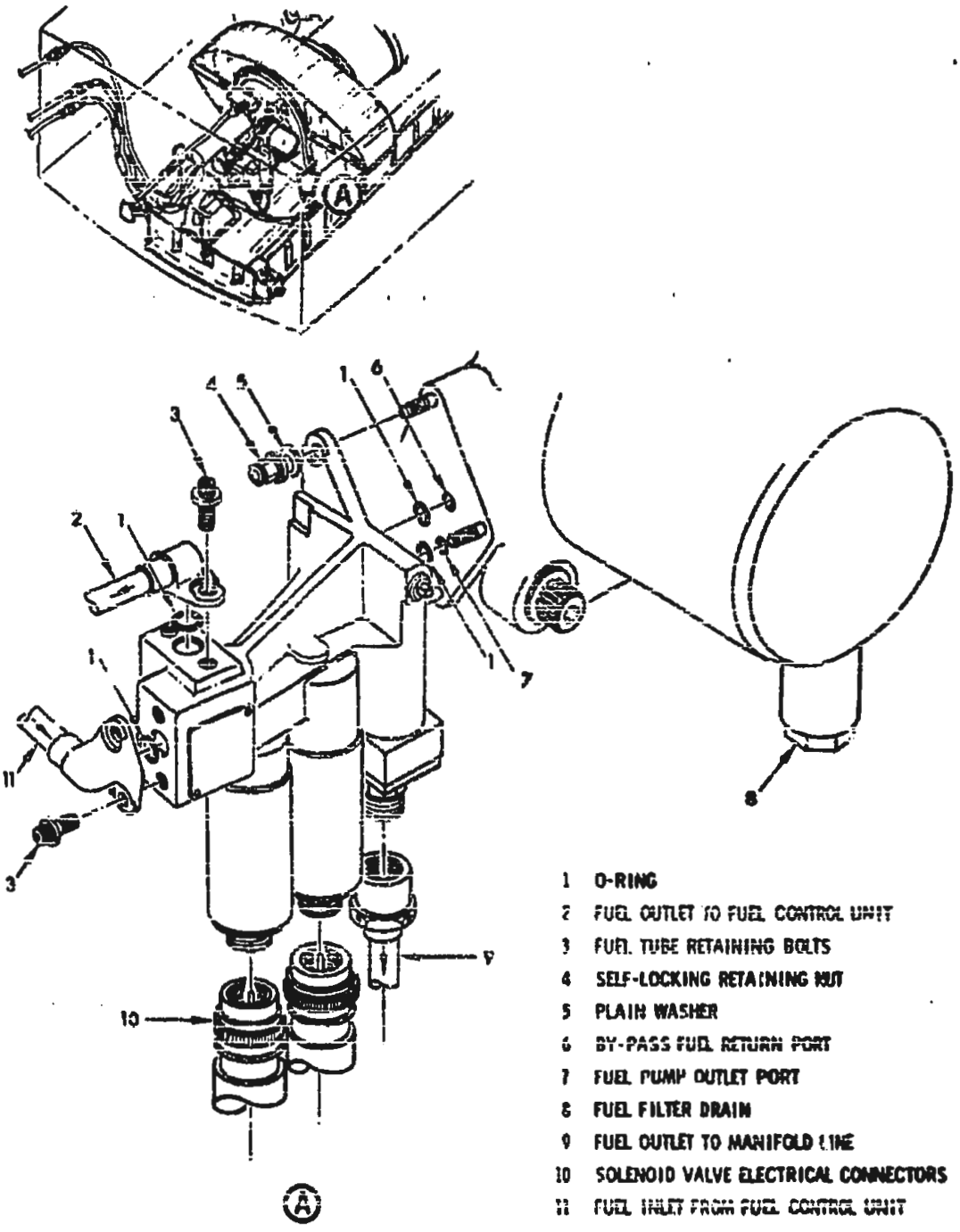
(5) Remove the bolts securing the fuel inlet line to the valve. Discard the O-ring.

(6) Remove bolts securing the fuel outlet line to the
R valve. (7) Remove fuel control unit (Ref. 49-31-02).

R Discard the O-ring.

R (8) Remove the three self-locking nuts and plain washers which secure the valve to the fuel pump and remove the valve. Discard O-rings.

B. Installation


A
A
1 O-RING
2 FUEL OUTLET TO FUEL CONTROL UNIT
3 FUEL TUBE RETAINING BOLTS
4 SELF-LOCKING RETAINING NUT
5 PLAIN WASHER
6 BY-PASS FUEL RETURN PORT
7 FUEL PUMP OUTLET PORT
8 FUEL FILTER DRAIN
9 FUEL OUTLET TO MANIFOLD LINE
10 SOLENOID VALVE ELECTRICAL CONNECTORS
11 FUEL INLET FROM FUEL CONTROL UNIT

HH 7881
P41-0100-49-125

Automatic Fuel Shutoff Valve - Removal and Installation
Figure 401

(1) Clean the mating faces of the fuel pump and the valve.

(2) Insert new O-rings into the recesses at the bypass fuel return port and the fuel pump outlet port on the valve assembly.

(3) Position the valve assembly on the fuel pump studs and secure with three plain washers and self-locking nuts. torque the nuts 65 to 85 lb in.

(4) Install fuel control unit on fuel pump (Ref. 49-31-02).

(5) Insert new O-rings into the recesses at the fuel inlet and outlet ports on the valve.

(6) Secure the inlet and outlet line flanges with bolts. Torque the bolts 20 to 30 lb in. and lock-wire.

(7) Connect the fuel outlet to manifold line. Torque coupling nut 90 to 100 lb in. and lock-wire.

CAUTION: THE SOLENOID VALVE ELECTRICAL CONNECTORS MUST ONLY BE HAND TIGHTENED.

(8) Remove tags and connect the solenoid value electrical connectors. Ensure the correct connector is on the correct solenoid and hand tighten. CR

(9) Check installation for leaks by performing the following steps.

(10) Turn on electrical power (Ref. 24-41-00).

(11) On the Flight Engineer/Second Officers aft circuit breaker panel, zone 215, open and tag the APU BAT BUS - IGNITION circuit breaker.

CAUTION: CHECK THAT THE NUMBER 2 ENGINE FUEL SYSTEM IS READY TO PRESSURIZE BEFORE OPERATING THE APU TANK VALVE AND PUMP.

(12) Place the APU switchlight on the Flight Engineer/Second Officers FUEL SYSTEM panel (zone 215) in the on (depressed) position.

NOTE: The LOW and bar indicators in the APU switchlight and the bar indicator in the APU TANK VALVE indicator will come on if the system is operating.

R (13) Remove the Maintenance-in-Progress tag from the MASTER
R POWER switch on the APU CONTROL panel and place the
R switch in the ON position.

R (14) Check the fuel pump installation for leaks. Repair any leaks before proceeding to next step.

WARNING: THE APU ENGINE AIR INLET DOOR AND THE VENT EJECTOR DOORS WILL OPERATE WHEN THE START AND STOP SWITCHES ARE PRESSED. BE SURE ALL PERSONNEL AND EQUIPMENT ARE CLEAR OF THE DOORS.

R (15) Press the START switchlight, on the APU CONTROL panel, and hold for approximately 2 seconds before releasing. The APU will motor through a hung start cycle lasting approximately 50 seconds. Observe the fuel pump installation for leaks during the motoring.

R (16) Press the STOP switch. After the APU has stopped
R motoring, place the APU switchlight in the off (out)
R position.

R (17) Place the MASTER POWER switch in the OFF position.

R (18) Remove tag and close the APU BAT BUS - IGNITION circuit
R breaker.

R (19) Turn off electrical power (Ref. 24-41-00).

R (20) Drain drip tank after completion of leak check.

R (21) Check APU compartment for cleanliness, close and secure access door.

C FUEL NOZZLE AND ADAPTER ASSEMBLY - REMOVAL AND INSTALLATION

C 1. Equipment and Materials

C Drain pan

Lock-wire, Fed Spec QQ-W-390, 0.020-inch diameter, or equivalent

Preformed packings (Ref. Fig. 401).

C Tool - Fuel transfer tube removal/installation 49-31-04-0010.

2. Referenced Procedures

24-41-00	External Power Ground Service System - Maintenance Practices
49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

NOTE: In accomplishing the following maintenance actions, it is recommended that all elastomeric seals which are routinely disturbed by maintenance be replaced.

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, open and tag circuit breaker APU BAT BUS - CONT PWR (S12).

(2) In aft fuselage, zone 316, open APU compartment access doors 319AL, 319BR, 319CL, and 319DL.

C CAUTION: ENSURE APU HAS COOLED SUFFICIENTLY TO PERMIT SKIN
C CONTACT.

C (3) Place drain pan beneath fuel inlet adapter (Ref. Fig.
C 401).

C (4) Remove bolts and locking plate from nozzle adapter
C being replaced and the adjacent nozzle adapter.

C NOTE: Reinstall bolts in the adjacent adapter to hold
C it in place while the fuel transfer tubes are
C being moved.

C (5) Using tool 49-31-04-0010 slide the fuel transfer tubes C out of the nozzle adapter being replaced.

C (6) Remove the fuel nozzle adapter and sheath.

C (7) Remove the four fuel transfer tube.

C NOTE: The gasket and insulation plate (See Fig. 401) C should be reused if serviceable. If a new C gasket is used the nozzle adapter bolts must be C torqued and then retorqued after one half hour.

C B. Installation

C (1) Install new preformed packings on ends of each fuel C transfer tube.

C (2) Insert transfer tubes into each fuel manifold adapter C using tool 49-31-04-0010.

C (3) Secure each adapter with a locking plate and bolts. C Torque bolts 20 to 30 lb. in. (See note above for C torquing requirements).

C (4) Remove drain pan.

C (5) Turn on electrical power (Ref. 24-41-00).

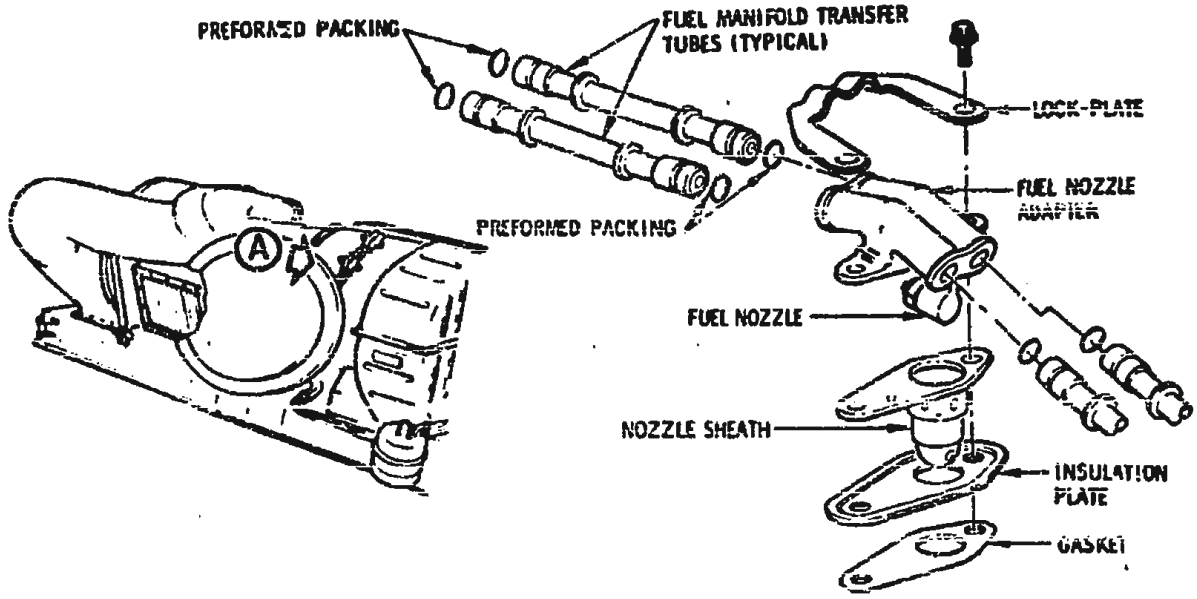
C (6) Remove tag and close circuit breaker opened in Step C 3A(1).

(7) Start APU and check for fuel leaks and operation (Ref. 49-00-01).

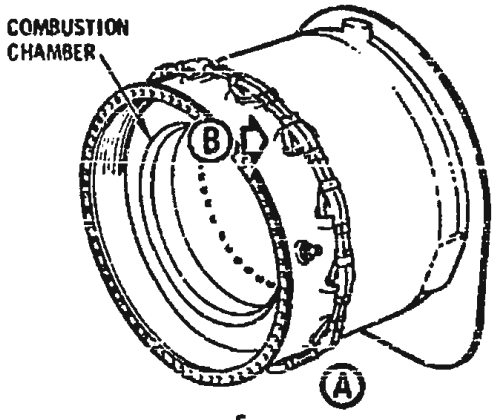
C (8) After shut-down, retorque and lock-wire adapter bolts C installed in Step 3A(7) and 3A(8).

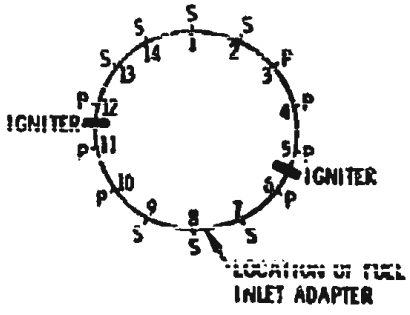
C (9) Close access doors.

(10) Turn off electrical power (Ref. 24-41-00).

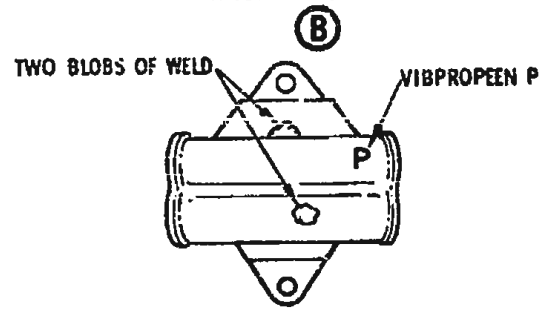


TYPICAL NOZZLE ADAPTER INSTALLATION (POSITION 13 SHOWN)

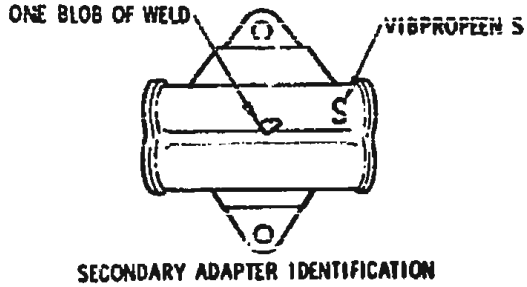




PRIMARY (P) AND SECONDARY (S) NOZZLE ADAPTER LOCATIONS (VIEWED FROM ENGINE ACCESSORY GEARBOX)



PRIMARY ADAPTER IDENTIFICATION



SECONDARY ADAPTER IDENTIFICATION

M1-0100-49-668

Fuel Nozzle and Adapter Assembly - Removal and Installation
Figure 401

FIREWALL FUEL SHUTOFF VALVE - REMOVAL AND INSTALLATION

1. Equipment and Materials

Container (3 to 5 gallon)

MS21913-( ) plug

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

24-41-00	External Power/Ground Service System - Maintenance Practices
49-31-16	Firewall Fuel Shutoff Valve - Adjustment and Test

3. Removal/Installation

A. Removal

(1) Apply external electrical power (Ref. 24-41-00) and close ENGINE 2 TANK VALVE. If external electrical power is not available, enter hydraulic service center and manually close the ENGINE 2 TANK VALVE.

(2) On APU CONTROL panel, attach MAINTENANCE-IN-PROGRESS tag to MASTER POWER switch.

(3) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers (B9, B10, B15, and B16). R

(4) Enter lower afterbody area through access door 317BB.

(5) Disconnect electrical harness plug at valve assembly being removed (Ref. Fig. 401).

(6) If secondary fuel shutoff valve is being replaced, manually close the primary fuel shutoff valve. If primary fuel shutoff valve is being replaced, manually close the secondary fuel shutoff valve and proceed with note preceding Step (10).

NOTE: Have container ready to catch fuel in APU fuel feed line between valve and APU.

(7) Disconnect APU fuel feed line at outlet of secondary valve.

(8) Back off fuel line B-nut at inlet port of secondary valve.

(9) Remove secondary valve support bolts and remove valve assembly.

NOTE: Have container ready to catch fuel when fuel inlet hose to primary valve is disconnected. Have plug ready to cap disconnected line.

(10) Disconnect fuel inlet hose and direct fuel flow into container. Reach into container and cap the line.

(11) Back off fuel line B-nut at outlet port of primary valve.

(12) Remove primary valve support bolts and remove valve assembly.

B. Installation

(1) Verify that circuit breakers opened in Step 3A(3) are open and tagged.

(2) If secondary fuel shutoff valve is being installed, place valve in installed position and engage fuel inlet line B-nut to inlet port fitting. If primary shutoff valve is being installed, proceed with Step 9.

(3) Install valve support bolts.

(4) Connect APU fuel feed line to outlet port fitting.

(5) Tighten fuel inlet and outlet line nuts.

CR (6) Connect electrical harness plug to actuator receptacle.

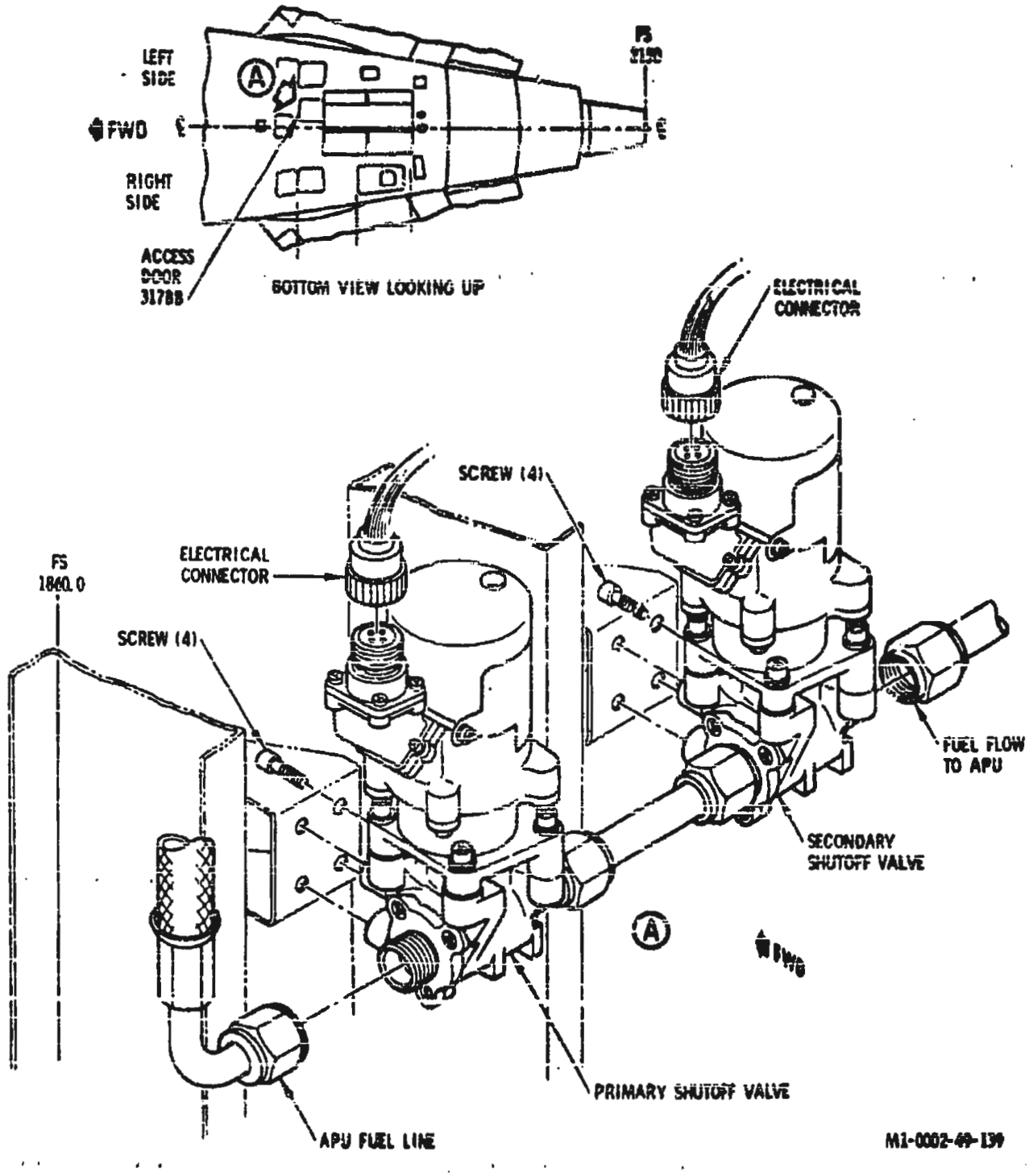
(7) Verify that valve actuator override lever is in the OPEN position.

(8) If only the Secondary Fuel Shutoff Valve is being replaced, proceed with Step 3A(16).

(9) Engage primary valve outlet port fitting to fuel line nut.

(10) Install valve support bolts.

(11) Place fuel catch container under valve inlet port.



R Fuel Shutoff Valve - Removal and Installation
R Figure 401

(12) Remove fuel inlet hose plug and connect hose assembly to valve inlet fitting.

(13) Tighten fuel inlet and outlet line nuts.

CR (14) Connect electrical harness plug to actuator receptacle.

(15) Verify that valve actuator override lever is in the CLOSED position.

(16) On FE/SO aft circuit breaker panel CB3, remove tags and close circuit breakers (B9, B10, B15 and B16).

(17) Perform Operational Check (Ref. 49-31-16).

(18) Open Eng 2 Tank Valve closed in Step 3A(1).

(19) Close access door 317BB opened in Step 3A(4).

FIREWALL FUEL SHUTOFF VALVE - ADJUSTMENT AND TEST

1. Referenced Procedures

24-00-00	Electrical Power System - Maintenance Practices
49-31-16	Firewall Fuel Shutoff Valve - Removal and Installation
49-31-18	Firewall Fuel Shutoff Valve - Removal and Installation

2. Adjustment/Test

A. Operational Test

NOTE: With APU shutdown, the APU primary emergency fuel shutoff valve is normally closed. The valve is opened when APU MASTER power is applied. The APU secondary emergency fuel shutoff valve is normally open at all times. Both valves are automatically closed by the APU compartment fire detection system or by manual actuation of the FE/SO APU FIRE PULL T-handle.

(1) Apply external electrical power (Ref. 24-00-00).

NOTE: In event only aircraft battery power is available, place BATTERY switch on FE/SO ELECTRICAL panel to ON position. Place switch back to OFF position when tests are completed.

(2) On FE/SO aft circuit breaker panel CB3, open and tag APU BAT BUS - IGNITION circuit breaker (S11).

NOTE: If test is being conducted to check operation of a replaced APU primary or secondary fuel shutoff valve assembly (Ref. 49-31-16 or 49-31-18), station an observer in the lower afterbody, zone 317, to check the installation for fuel leaks.

(3) On FE/SO APU CONTROL panel, place APU MASTER POWER switch to ON position. Verify that the APU primary emergency fuel shutoff valve opens (APU EMERGENCY SHUTOFF PRI light on, then off). R

(4) Initiate an APU motoring cycle by momentarily depressing APU START switch.

CAUTION: DO NOT ACTIVATE FIRE EXTINGUISHING SWITCHES EXPOSED WHEN FIRE PULL T-HANDLE IS PULLED DOWNWARD.

(5) As the Ng indicator pointer starts to move upscale, pull the APU FIRE PULL T-handle downward. Verify the following results:

R (a) DOOR IN TRANSIT light on, then off.

R (b) Both APU primary and secondary emergency fuel
R shutoff valves close (APU EMERGENCY SHUTOFF PRI
R and SEC light on, then off).

R (c) Ng falls off (after approximately 50 seconds).

(6) Return FIRE PULL T-handle to fully stowed position.

On FE/SO APU CONTROL panel, place Master Power switch to the OFF position. Place the APU Master Power switch back to the ON position and verify that the APU Primary Emergency Shutoff Valve opens (APU Emergency Shutoff Primary light comes on then goes off).

(7) Press the APU START switch. Verify the following results:

(a) APU DOOR IN TRANSIT light on, then off.

(b) APU secondary emergency fuel shutoff valve opens (APU EMERGENCY SHUTOFF SEC light on, then off).

(8) Abort the APU motoring cycle by depressing the APU stop button. Observe DOOR IN TRANSIT light on, then off.

(9) On FE/SO APU CONTROL panel, place the APU Master Power switch to the OFF position. Verify that primary fuel shutoff valve closes (APU emergency fuel shutoff PRI light on, then off).

NOTE: This will occur only if external power is applied.

(10) On FE/SO aft circuit breaker panel CB3, remove tag and close APU BAT BUS - IGNITION Circuit Breaker (S11) opened in Step 2A(2).

(11) Remove external electrical power (24-00-00).

R FUEL FLOW DIVIDER AND DUMP VALVE - REMOVAL AND INSTALLATION

R 1. Equipment and Materials

R Preformed Packing (Ref. Fig. 401)

R Lock-wire, Fed. Spec. QQ-W-390, 0.032-inch diameter, or
R equivalent

R Lubricant, Dow Corning 44A (Dow Corning Corp, Midland, Mich), or
R equivalent

R Drain pan

R 2. Referenced Procedure

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

R 3. Removal/Installation

R A. Removal

R (1) On FE/SO aft circuit breaker panel CB3, zone 215, open
R and tag APU power circuit breakers 89 through 817.

R (2) Open APU compartment access doors.

R (3) Place drain pan under the fuel flow divider and dump
R valve. Disconnect the fuel inlet line and allow
R residual fuel to drain into drain pan.

R (4) Disconnect fuel dump line.

R (5) Remove four valve attach bolts and separate valve from
R fuel manifold inlet adapter. Discard preformed packing
R at fuel inlet ports to adapter.

R (6) Remove nipple and reducer fittings and retain for
R reinstallation.

R B. Installation

R (1) Verify that circuit breakers opened in Step 3A(1) are
R open and tagged.

R (2) Lubricate new preformed gasket with light film of Dow
R Corning lubricant and install on fuel inlet nipple.
R Install nipple in fuel flow divider and dump valve

R inlet port and tighten to torque of 40 to 60 lb in.
R Install lock-wire. (Ref. Fig. 401).

R (3) Install preformed packing on reducer fitting and
R install in fuel dump port as in preceding step (2).
R Tighten reducer fitting to a torque of 40 to 60 lb in
R and install lock-wire.

R (4) Lubricate preformed packing and install at fuel adapter
R ports.

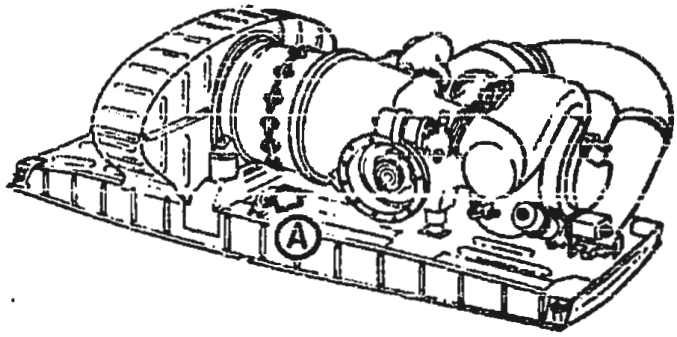
R (5) Hold flow divider and dump valve in installed position
R and install attach bolts. Tighten bolts to a torque of
R 24 to 36 lb in. and add lock-wire.

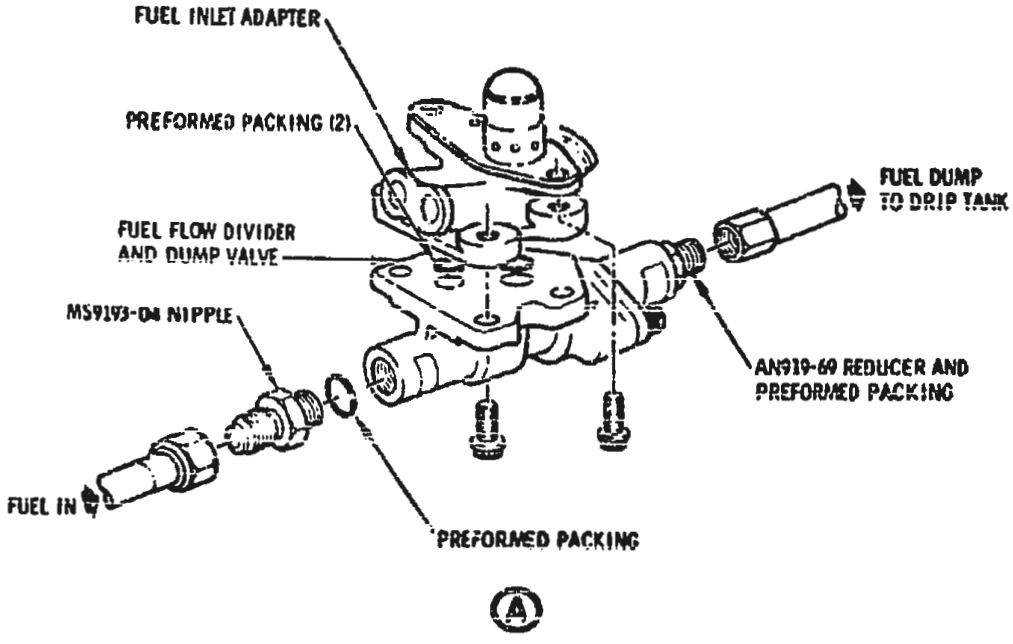
R (6) Connect fuel inlet and fuel dump lines and lock-wire
R tube nuts.

R (7) Remove tags and close circuit breakers opened in Step
R 3A(1).

R (8) Operate APU and check for fuel leaks (49-00-01).

R (9) Close APU access doors and rotate fluid scupper catcher
R aft against access door.





M1-0100-49-660

R Fuel Flow Divider and Dump Valve - Removal and Installation
R Figure 401

R EFFECTIVITY: ALL
R
001B

FIREWALL FUEL SHUTOFF VALVE ACTUATOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

24-41-00 External Power/Ground Service System - Maintenance Practices

R 49-31-16 Firewall Fuel Shutoff Valve - Adjustment and Test

3. Removal/Installation

A. Removal

R (1) On APU control panel attach MAINTENANCE IN PROGRESS tag
R to APU MASTER POWER switch.

R (3) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 315, open and tag APU POWER circuit
R breakers (B9 thru B10, and B15 thru B16).

R (3) Gain access to APU primary and secondary fuel shutoff
R valves through access door 317BB.

R (4) Disconnect electrical harness plug at shutoff valve
R actuator (Ref. Fig. 401).

R (5) Remove valve actuator to body attach screws and
R disengage actuator from valve body (Ref. Fig. 401).

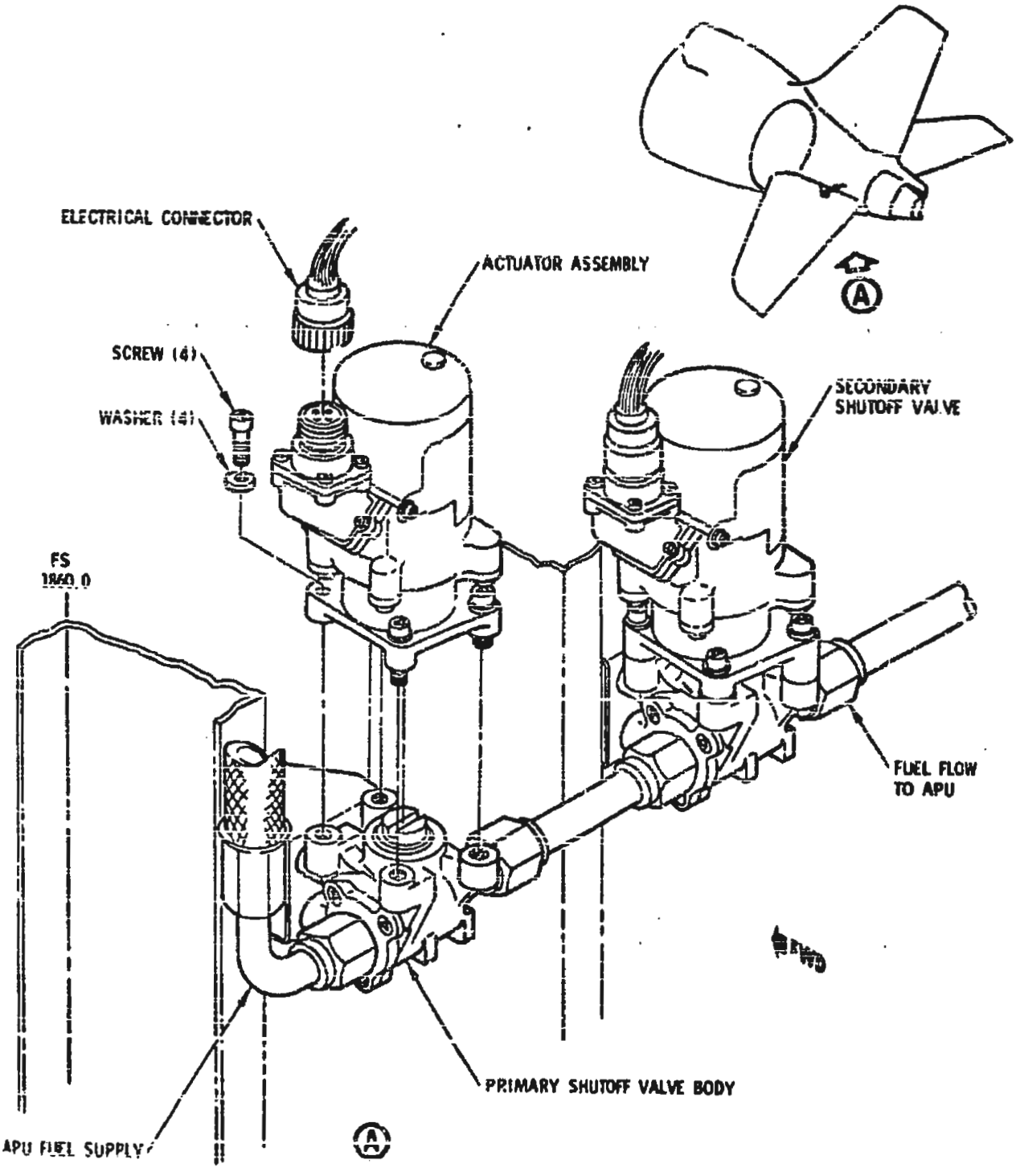
B. Installation

(1) Verify that circuit breakers opened in Step 3A(3) are open and tagged.

R (2) Engage valve actuator drive shaft to valve body and
R install actuator attach screws (Ref. Fig. 401).

R NOTE: Actuator manual override lever may have to be
R rotated to open or closed position to permit
R driveshaft engagement.

R (3) Connect electrical harness plug to actuator and install
R lock-wire.



M1-0100-49-704

R R Fuel Shutoff Valve Actuator - Removal and Installation
Figure 401

EFFECTIVITY: ALL

001B

R R (4) Check operation of firewall fuel shutoff valve (Ref. 49-31-16).

FCU P3 AIR FILTER ELEMENT - REMOVAL AND INSTALLATION

1. Equipment and Materials

R Filter Element (Ref. Fig. 401)

R Preformed Packing, Filter Element (Ref. Fig. 401)

R Preformed Packing, Filter Bowl to Filter Head (Ref. Fig. 401)

Cleaning Solvent, Acetone (Fed. Spec. O-A-51) or Aerosol Swish Electrokleen (Montgomery Chemical Co., Gloucester, N.J. 08030), or equivalent

Lock-wire, Fed. Spec. QQ-W-390, 0.032-inch diameter, or equivalent

Lubricant, Dow Corning 44A, or equivalent

Lubricant, Petrolatum Graphite (MIL-T-5544)

2. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag CONT PWR (S12) and BAT PWR circuit breaker (B10).

R R (2) Attach MAINTENANCE IN PROGRESS tag to APU CONTROL panel.

R (3) Open APU compartment access doors 319AL and 319CL.

R (4) Remove filter cover (Ref. Fig. 401).

R (5) Remove and discard preformed packing on filter cover.

R (6) Remove filter element.

NOTE: Do not discard removed filter element; element is reusable and should be sent to an appropriate shop facility for cleaning.

R (7) Clean filter head and cover with cleaning solvent.

B. Installation

R (1) Lubricate new pre-formed packing with a very light film of Dow Corning 44A, or equivalent lubricant, and
R install in recessed area of filter element (Ref. Fig.
R 401).

(2) Insert filter element into filter housing.

R (3) Lubricate new pre-formed packing with a light film of
R Dow Corning 44A, or equivalent lubricant, and install
R packing on filter cover.

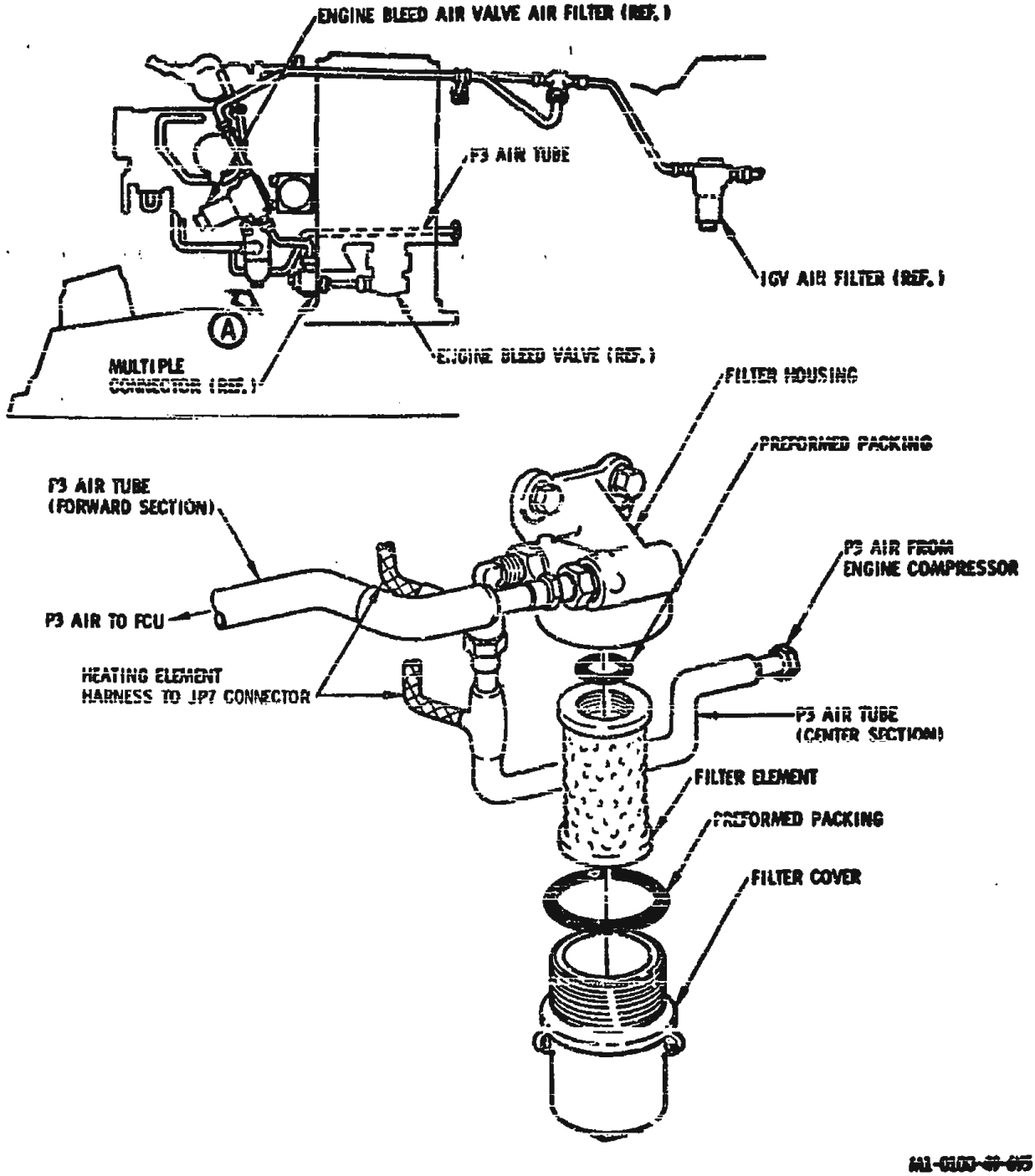
(4) Apply a thin film of petrolatum graphite to threads of filter bowl.

(5) Install filter bowl. Tighten bowl to a torque of 130 to 150 lb in. and lock-wire bowl to filter housing.

(6) Close APU compartment access doors.

(7) Remove tags and close circuit breakers opened in Step 2A(1).

R (8) Remove MAINTENANCE IN PROGRESS tag at APU CONTROL
R panel.



R FCU P3 Air Filter Element - Removal and Installation
R Figure 401

R EFFECTIVITY: ALL
R
001B

IGNITION AND STARTING SYSTEM - DESCRIPTION AND OPERATION

1. General

The APU gas turbine engine is rotated to a self-sustaining level of operation by a 28 volt dc starter motor. The starter is mounted on the engine accessory gearbox and engaged to the gearbox drive train by a splined coupling of the starter output shaft and starter driven shaft in the gearbox. It remains engaged to the gear drive train at all times, except on APU's equipped with an overrunning clutch (APU's with stock list number L145). Electrical power input harness leads are connected to terminal studs at the commutator end of the starter and protected by insulator boots or a bolted-on cover. The unit is operationally limited to no more than two consecutive starts (with a 60-second off cooling period between starts). A one hour cooling period must be allowed before attempting another start.

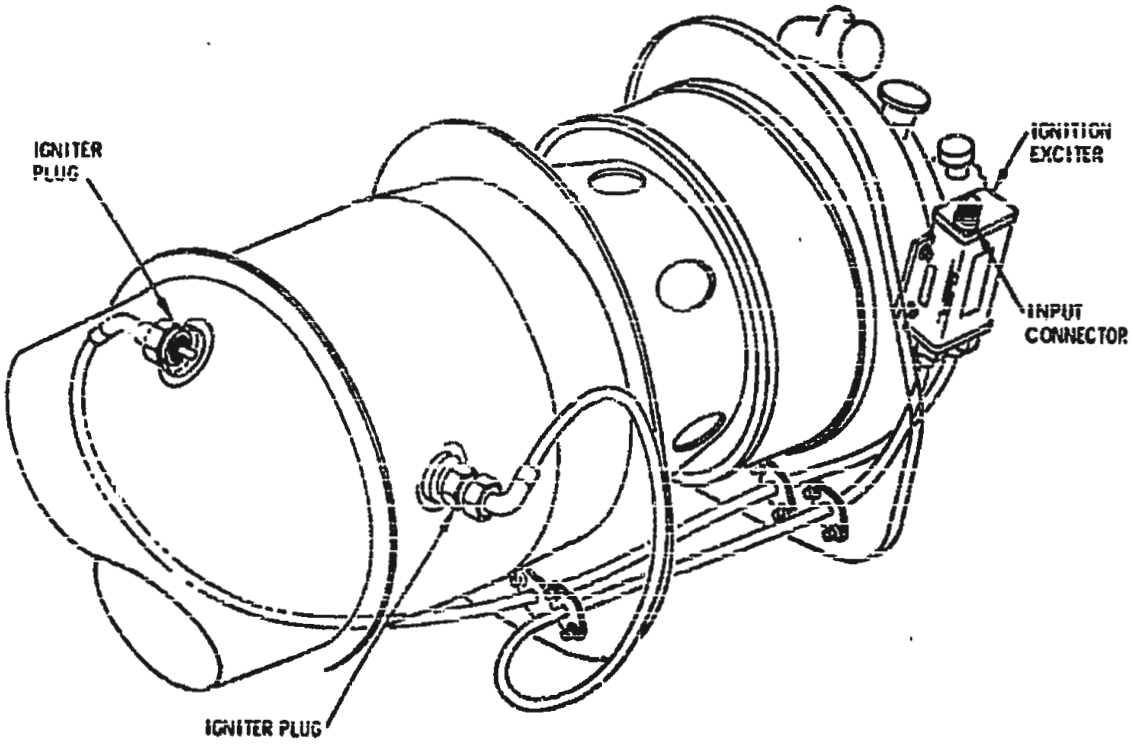
Ignition of fuel in the gas turbine combustion chamber, during the APU start sequence, is initiated by a low-voltage, high-energy ignition system consisting of an ignition exciter unit and two igniter plugs (Ref. Fig. 1). The igniter plugs are retained in threaded bosses at the combustion chamber 4 o-clock and 9 o-clock positions and connected to the exciter by two shielded cables.

The igniter plugs are basically threaded shells having an insulated center electrode. The annular gap between electrode and shell is shunted with a semiconductive material. In operation, a rising potential developed in the ignition exciter and applied to the center electrode causes a current across the semiconductive material. As this current increases, the air in the annular gap ionizes and causes a high energy electrical discharge across the semiconductive material. Ignition is continuous until terminated by the electronic control unit (ECU) at 55 percent Ng rpm.

2. Igniter Plugs

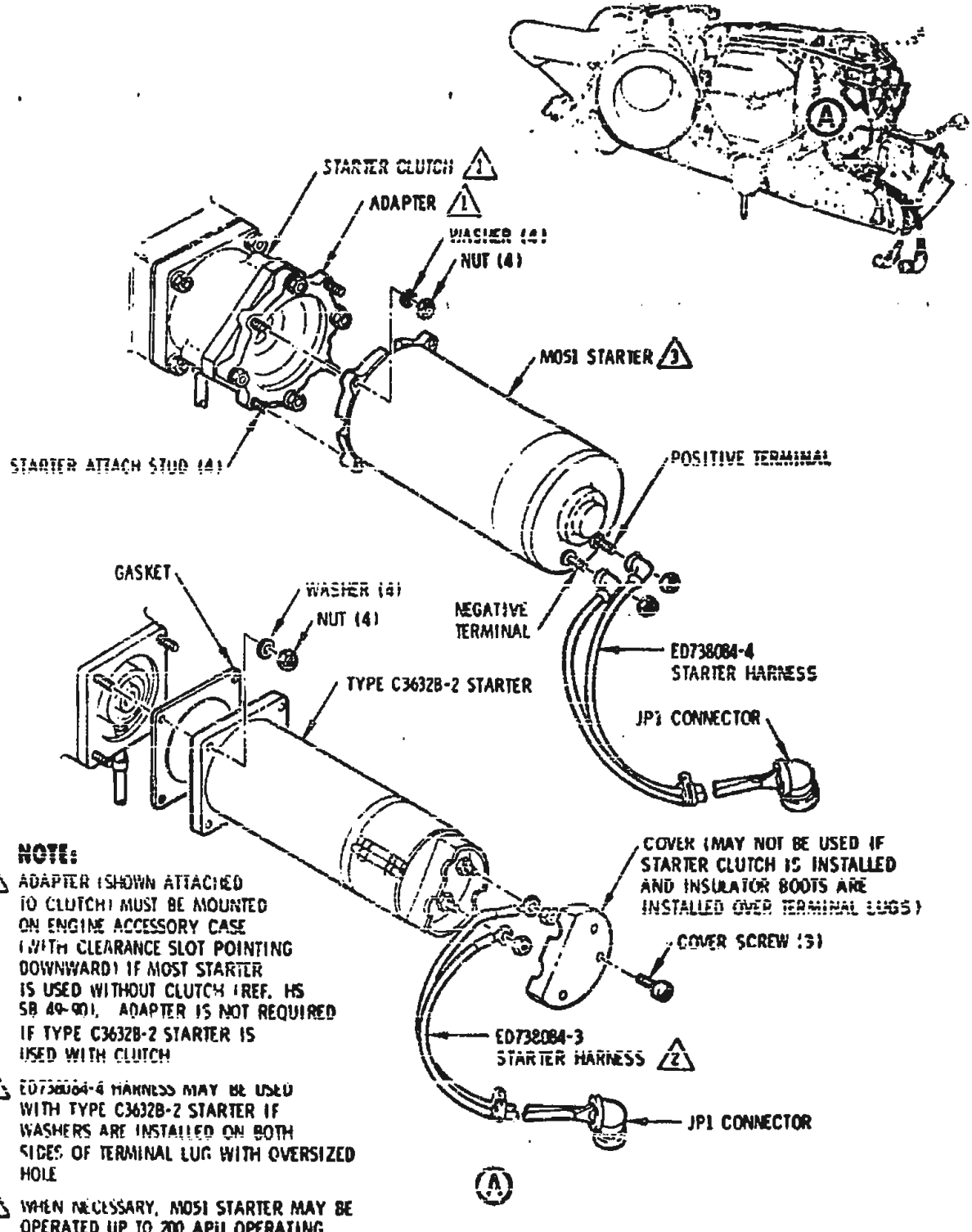
A. Description and Operation

The two engine igniter plugs are threaded into bosses located in the combustion chamber case at the 4-o'clock and 9-o'clock positions (as viewed from the accessory gearbox end of the engine). Each igniter consists of a threaded shell having a central positive electrode surrounded by semiconducting material. The igniters are connected to the ignition exciter unit by shielded electrical cables.



HH 5824
M1-A33-3-042

APU Ignition System
Figure 1



NOTE:

1. ADAPTER (SHOWN ATTACHED TO CLUTCH) MUST BE MOUNTED ON ENGINE ACCESSORY CASE (WITH CLEARANCE SLOT POINTING DOWNWARD) IF MOSI STARTER IS USED WITHOUT CLUTCH (REF. HS SB 49-901). ADAPTER IS NOT REQUIRED IF TYPE C3632B-2 STARTER IS USED WITH CLUTCH
2. ED738084-4 HARNESS MAY BE USED WITH TYPE C3632B-2 STARTER IF WASHERS ARE INSTALLED ON BOTH SIDES OF TERMINAL LUG WITH OVERSIZED HOLE
3. WHEN NECESSARY, MOSI STARTER MAY BE OPERATED UP TO 200 APU OPERATING HOURS WITHOUT A CLUTCH

M1-0003-49-127

R
R

APU Starter
Figure 2

EFFECTIVITY: ALL

0018

The igniters are used only when starting the engine to initiate combustion.

3. Ignition Exciter

A. Description and Operation

The ignition exciter is a sealed unit containing electronic components encased in an epoxy resin. In operation, a capacitor on the secondary, high-voltage side of a transformer is progressively charged until the energy is sufficient to ionize a spark gap and discharge the capacitor across two igniters installed in the APU combustion case liner. The exciter is attached to a support bracket mounted on the APU accessory gearbox and connected to the igniters by two shielded cables.

4. Engine Starter

NOTE: Either a Type C3632B-2 or M051 starter may be installed on the APU. The M051 starter is factory installed on APU's having modification data plate stock list number L143 and retrofitted on earlier units by HS SB49-90 which adds the L143 stock list identity. The starters may be mounted to the accessory gearbox starter drive pad or an overrunning clutch which is attached to the pad prior to starter installation. The clutch is factory installed on APU's having stock list number L145 and is retrofitted on earlier units by HS SB49-90 which adds the L145 identity. Installation procedures for each starter are essentially the same except that an adapter plate is required for installation of the larger diameter M051 starter.

A. Description and Operation

The Type C3632B-2 APU starter is basically a four-pole, four-brush, totally enclosed, series-wound 28V dc motor. The starter consists of a commutator-end housing, drive-end housing, a magnet containing four series-wound field coils, and the starter armature.

The M051 starter (Ref. Fig. 2) is a four pole, eight brush, 28 volt dc series-wound motor. The unit is comprised of five sub-assemblies: a commutator end-housing containing an armature support bearing and four brush holders, a yoke assembly containing the four series-wound coils field coils, a drive end-housing, an armature, and the starter drive shaft. The drive end-housing supports an armature bearing and provisions for attaching the starter to the adapter required for mounting the starter to engine starter drive

pad or clutch. Access to the brushes is acquired by removing a cover that encircles the commutator end-housing. The electrical power input harness leads are connected to 5/16 and 7/16 diameter terminal studs which assure correct polarity hook-up of the power input leads.

5. Starter Clutch

A. Description and Operation

The APU starter clutch (Ref. Fig. 2) is essentially a mechanical device which uses a sprag-type clutch to decouple the APU starter after the APU is started and the rpm of the starter driven shaft exceeds starter rpm. The starter is then not constantly motored by the engine as would be if mounted directly to the engine starter drive pad. The clutch consists of the following components: A cylindrical housing having a lubricating oil supply sump and a support flange for mounting the unit to the engine starter drive pad, an end-housing which supports the clutch input shaft bearing and four studs for mounting a Type C3632B-2 starter or an M051 starter mount adapter, the internally splined input shaft, the sprag clutch assembly and its support bearings, and an externally splined output shaft which is internally splined to the sprag clutch. An oil quantity indicator dip-stick is located on the side of the clutch housing and secured by a spring clip.

R 6. Starter Harness

A. Description

The APU starter harness connects the starter power input terminals to the aircraft wiring starter power input receptacle located on the forward wall of the APU compartment. The harness consists of a two pin connector plug, two AWG No. 2 shielded, nickel clad, and teflon wrapped copper wires, a cable clamp for securing the harness to the APU compartment wall, and a terminal stud lug and grommet at the starter end of each wire. Two harness assemblies are provisioned, each identified by a heat shrunk identification plate sleeve and the starter terminal lug configuration. The harness having identical size terminal lugs is used only with a Type C3632B-2 starter. The harness having an insulating boot over each lug and one lug with a larger size terminal stud hole is provisioned for use with an M051 starter; the different size lugs assuring proper polarity hook-up to the starter. This harness may be used with a Type C3632B-3 starter as directed in the starter installation instructions (Ref. 49-41-04).

7. APU Starter Relay

A. Description and Operation

BAT BUS power (Ref. Fig. 2) is applied to the APU starter through the A1-A2 contacts of APU STARTER RELAY (4941-K1) located in the mid electrical service center BATTERY POWER BOX, zone 137. The K1 relay is energized, during the APU start sequence, by the electronic control unit. With the relay energized, a circuit completed through contacts 11 and 12 energizes APU SHUNT relay (2436-K6), also located in the BATTERY POWER BOX.

The shunt relay puts a resistor in parallel with the shunt provided for the DC AMPS meter on the Flight Engineer/Second Officers ELECTRICAL control panel.

This makes it possible for the battery drain current incurred by starter operation to be monitored on the meter (Ref. 24-31-00).

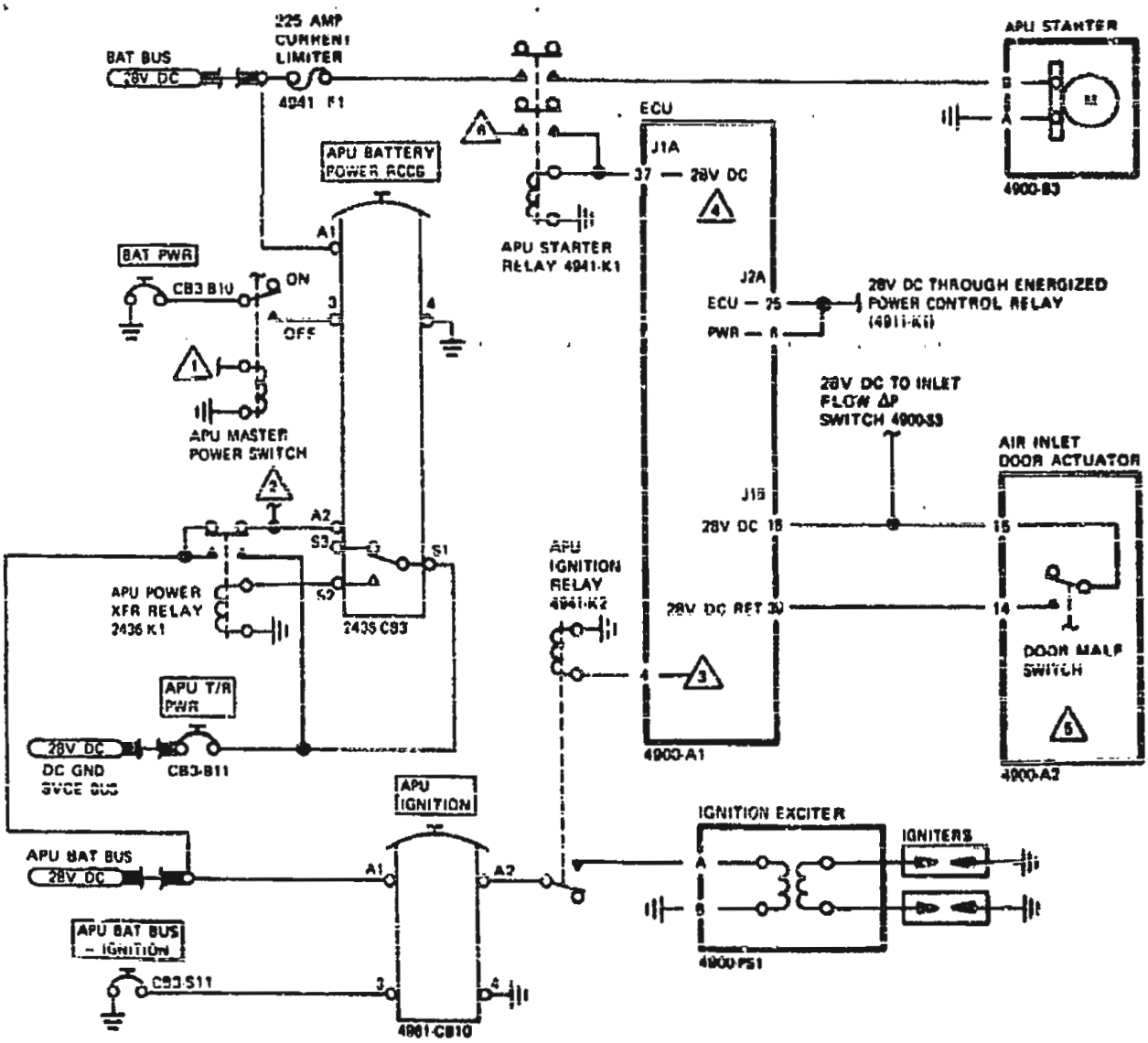
8. System Operation

APU starter and ignition operation (Ref. Fig. 3) is automatically initiated and controlled by the APU electronic control unit after the START switch on the Flight
R Engineer/Second Officers APU CONTROL panel is depressed.

With the MASTER POWER switch on, APU BATTERY POWER RCCB (2436-CB3) is closed and 28V dc BAT BUS power is applied to the APU continuous power circuits.

The APU BAT BUS is energized by 28V dc applied through contacts of deenergized APU POWER TRANSFER RELAY (2436-K1). Power is then available at terminal A2 of APU IGNITION RCCB (4961-CB10) for operation of the ignition exciter. If the GND SVCE BUS is energized, the APU POWER TRANSFER RELAY will be energized and the APU BAT BUS will then be powered by 28V dc from the GND SVCE BUS. The electronic control unit sequencing circuits will not
R initiate an APU start unless the APU air inlet door is open and power is applied to the ECU (Ref. 49-61-00). When this occurs, APU STARTER RELAY (4941-K1) is energized and 28V dc from the BAT BUS is applied through a 225-amp current limiter and the energized RELAY to the starter. When Ng rpm is greater than 10 percent, the ECU energizes the APU IGNITION relay (4941-K2) and 28V dc from the APU BAT BUS is applied to the ignition exciter.

At 55 percent Ng rpm, the APU should be self-sustaining and the ECU deenergizes the APU starter and ignition relays. If the ECU START/STOP timer lapses before the APU has started and attained 55% Ng, the ECU initiates an automatic shutdown. The starter



NOTE

1. 28V DC CONTINUOUS POWER
2. 28V DC TO TERM A1 OF POWER CONTROL AND CONTROLLER POWER RCCB'S
3. 28V DC DURING APU START WHEN ENGINE SPEED IS > 10% NG AND < 55% NG
4. ECU CUTS OFF 28V DC AND DEENERGIZES 4941-K1 AT 55% NG
5. SWITCH IS CLOSED WHEN INLET DOOR IS MORE THAN 48% OPEN
6. TO DC AMPS METER SHUNT RELAY (24-31-00)

EM1-58200-49-871

APU Starter and Ignition Systems Schematic
Figure 3

R

R EFFECTIVITY: ALL

R

power circuit will then remain energized for 10 seconds to purge the APU engine.

IGNITER PLUG - REMOVAL AND INSTALLATION

1. Equipment and Materials

R Anti-seize Compound (Silver Goop), or equivalent (Procurable
R from Crawford Fitting Co., 29500 Solon Rd., Solon, Ohio 46193)

R Igniter plug gasket

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Lubricant, Fluorocarbon Dry Spray, Zeplon Dry Spray Type I (Canadian Industrial Chemicals Lts., P.O. Box 173, Montreal 300, Quebec, Canada), or equivalent. MS-122 (procured from Miller-Stephenson Chemical Co. Inc., P.O. Box 628, Danbury, Conn. 06810) is an approved equivalent

2. Referenced Procedures

49-00-01 Airborne Auxiliary Power - Adjustment and Test

49-41-01 Igniter Plug - Inspection and Check

3. Removal/Installation

A. Removal

WARNING: OUTPUT VOLTAGES GENERATED IN THE IGNITION SYSTEM EXCITER CAN CAUSE SERIOUS INJURY TO PERSONNEL. THE APU BAT BUS - IGNITION (CB3-S11) CIRCUIT BREAKER SHOULD BE OPENED AND THE APU POWER HARNESS JPI CONNECTOR DISCONNECTED TO ASSURE REMOVAL OF POWER FROM THE EXCITER. ALWAYS WAIT SEVERAL MINUTES FOR VOLTAGES IN THE EXCITER TO BLEED DOWN BEFORE WORKING ON THE HIGH TENSION PORTION OF THE IGNITION SYSTEM. DISCONNECT AND GROUND OUT THE HIGH TENSION IGNITION CABLE AT THE IGNITER WHEN REMOVING THE EXCITER OR AN IGNITER.

(1) On the Flight Engineer/Second Officers APU CONTROL panel, zone 215, ensure that the MASTER POWER switch is in the OFF position. Attach a MAINTENANCE-IN-PROGRESS tag to the APU CONTROL panel.

(2) On Flight Engineer/Second Officers circuit breaker panel CB3, zone 215, open and tag the APU BAT BUS - IGNITION (S11) circuit breakers.

(3) Open the APU compartment access doors.

(4) Disconnect APU power harness connector JP1 at the APU compartment forward bulkhead.

(5) Disconnect igniter cable at the igniter and discharge any stored charge in the exciter by grounding the cable terminal to the engine.

(6) Remove the igniter using a conventional 3/4-inch socket.

B. Installation

(1) Inspect igniter for evidence of any damage that would impair igniter serviceability (Ref. 49-41-01, Igniter Plug - Inspection and Check).

R R R (2) Place new gasket on igniter. Apply light film of anti-seize compound to igniter threads and install igniter.

R R R CAUTION: ENSURE THAT EDGE OF INSULATING BLANKET DOES NOT RUB AGAINST THREADED PORTION OF IGNITER AS IT IS BEING INSTALLED.

(3) Tighten igniter to a torque of 300 lb in., then completely loosen igniter and retorque 300 to 360 lb in. Install lock-wire.

(4) Lightly spray insulated end of igniter cable with fluorocarbon dry spray lubricant and connect igniter cable coupling nut. Tighten coupling nut fingertight plus 45 degrees and install lock-wire.

(5) Reconnect JP1 power harness connector at APU compartment forward bulkhead.

(6) Close APU compartment access doors and swing fluid catcher aft against scupper on access door.

(7) Remove tag and close circuit breaker opened in Step 3A(2).

(8) Remove MAINTENANCE-IN-PROGRESS tag from APU MASTER POWER switch.

R R (9) Start the APU and verify light off (rise in TGT) and acceleration of APU to normal operating speed (Ref. 49-00-01).

(10) Shutdown APU (Ref. 49-00-01).

IGNITER PLUG - INSPECTION AND CHECK

1. Referenced Procedure

R 49-41-01 Igniter Plug - Cleaning and Painting

2. Equipment and Materials

Volt-Ohm-Milliammeter, Simpson Model 260-6M, or equivalent

3. Inspection/Check

CAUTION: SHOULD AN IGNITER PLUG BE DROPPED, INTERNAL DAMAGE, POSSIBLY NOT DETECTABLE BY VISUAL INSPECTION OR TEST, CAN OCCUR. RECOMMENDATION IS TO REPLACE THE IGNITER PLUG.

A. Igniter Plug (Bendix P/N 10-380700-1)

(1) Clean igniter plug (Ref. 49-41-01, Cleaning and Painting).

(2) Inspect igniter shell and electrode for excessive erosion; if erosion equals or exceeds limits shown on Figure 601.

(3) Inspect the terminal end of the plug for any visible evidence of damage. Minor nicks, burrs, or slightly damaged threads which can be corrected by a few strokes of a fine file may be repaired. Reject plug whenever any of the following conditions exist:

(a) Insulator broken, cracked, or loose.

(b) Input connector pin noticeably damaged or bent.

(c) Center electrode badly burned, broken, or pitted.

(d) Flange and metal shield of firing end is bent, grooved, or eroded. Mating surface of flange must be flat and smooth.

(4) Check resistance between center electrode (contact outside of welded area) to the terminal pin. Resistance must be less than 1 ohm. Any further testing must be done using Bendix 11-4700, or
R equivalent, tester.

B. Igniter Plug (Champion P/N FHE182)

(1) Clean igniter plug (Ref. 49-41-01, Cleaning and Painting).

(2) Visually check the igniter plug for mechanical damage. Reject igniter plug if it shows impact evidence on the exterior shell, cracked or loose ceramic, bent or broken connector pin in terminal well, or chipped or cracked ceramic in annular firing gap. Chafing wear on the exterior cylindrical area of the firing end shell is acceptable to a depth not exceeding 0.015 inch. This measurement can be checked with a screw thread comparator No. 210 series micrometer caliper by Starrett.

(3) Check igniter plug for electrode erosion as follows (Ref. Fig. 601):

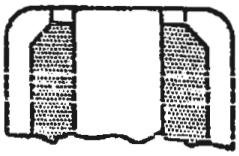
(a) Reject plug if center electrode is eroded more than 1/32 inch (measured from straight edge placed across tip of circular electrode).

(b) Reject plug if inner diameter of circular electrode has eroded to an enlarged diameter of 11/32 inch.

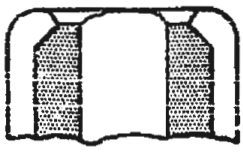
NOTE: Minor exterior nicks or chafe marks may be dressed using fine Swiss file or abrasive cloth.

R WARNING: OUTPUT VOLTAGES GENERATED IN THE IGNITION SYSTEM
R EXCITER CAN CAUSE SERIOUS INJURY TO PERSONNEL. THE
R APU BAT BUS - IGNITION (CB3-S11) CIRCUIT BREAKER
R SHOULD BE OPENED AND THE APU POWER HARNESS JPI
R CONNECTOR DISCONNECTED TO ASSURE REMOVAL OF POWER FROM
R THE EXCITER. ALWAYS WAIT SEVERAL MINUTES FOR VOLTAGES
R IN THE EXCITER TO BLEED DOWN BEFORE WORKING ON THE
R HIGH TENSION PORTION OF THE IGNITION SYSTEM.
R DISCONNECT AND GROUND OUT THE HIGH TENSION IGNITION
R CABLE AT THE IGNITER WHEN REMOVING THE EXCITER OR AN
R IGNITER.

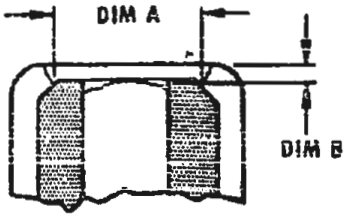
R (c) Electrically test igniter plug normal open air
R pressure, using the standard engine ignition
R system, or a bench test equivalent, such as the
R Bendix 11-9650 bench test set. Steady firing
R across the gap indicates the igniter is
R satisfactory.



NEW IGNITER



ACCEPTABLE WEAR



WORN OUT

EROSION LIMITS

IGNITER	DIM A	DIM B
BENDIX 10-360/UA-1	1/4 IN.	1/32 IN.
CHAMPION FHL-102	11/32 IN.	1/32 IN.

M1-0100-49-503

R R Igniter Erosion Limits
Figure 601

R R 0018 EFFECTIVITY: ALL

R # IGNITER PLUG - CLEANING AND PAINTING

R 1. Referenced Procedure

R 49-41-01 Igniter Plug - Inspection and Check

R 2. Equipment and Materials

R Solvent Methyl-Ethyl-Ketone (procurable from Collier Chemical
R Co., Binghamton, New York, 13902)

R 3. Cleaning

R A. Igniter Plug (Bendix P/N 10-380700-1)

R (1) Seal cable terminal end of igniter plug with rubber
R stopper or equivalent device to prevent entry of
R contaminated cleaning solvent.

R (2) Use a soft wire brush to clean the plug barrel and a
R cloth buffing wheel for threads. The nose (electrode
R end) of the igniter plug should never be cleaned. Any
R carbon on the tip aids operation of the plug.

R CAUTION: NEVER SAND BLAST OR USE A LIQUID SUSPENDED
R ABRASIVE FOR CLEANING IGNITER PLUG. ANY
R ABRASIVE ACTION REMOVES SEMI-CONDUCTOR
R MATERIAL IN GAP AREA AND ADVERSELY AFFECTS
R FUNCTIONING OF THE PLUG.

R (3) Blow any loose carbon or other loose foreign material
R from igniter plug with an air blast.

R WARNING: AVOID INHALATION OF METHYL-ETHYL-KETONE
R FUMES.

R (4) Remove rubber stopper (or equivalent) and wipe igniter
R plug with a clean lint free cloth dampened in
R methyl-ethyl-ketone.

R (5) Inspect igniter plug (Ref. 49-41-01, Inspection and
R check).

R B. Igniter Plug (Champion P/N FHE182)

R (1) Wipe excess contamination from the exterior of the
R igniter plug with a dry, clean cloth. Do not disturb
R the combustion deposits on the firing end or spark gap

area. These deposits in the gap area aid the igniter plug's operation.

WARNING: AVOID INHALATION OF METHYL-ETHYL-KETONE FUMES.

(2) Clean terminal well with a felt swab saturated in mineral solvent or methyl-ethyl-ketone, using caution not to damage the terminal pin.

(3) Inspect igniter plug (Ref. 49-41-01 Inspection and Check).

IGNITION EXCITER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

R Lubricant, Fluorocarbon Dry Spray, Zeplon Dry Spray Type I
R (Canadian Industrial Chemicals Ltd., P.O. Box 173, Montreal 300,
R Quebec, Canada), or equivalent. MS-122, procured from
R Miller-Stephenson Chemical Co., Inc., P.O. Box 628, Danbury,
R Conn. 06810 is an approved equivalent.

R 2. Referenced Procedures

R 49-00-01 Airborne Auxiliary Power - Adjustment and Test

R 49-41-01 Igniter Plug - Removal and Installation

R 49-41-01 Igniter Plug - Inspection and Check

3. Removal/Installation

A. Removal

WARNING: OUTPUT VOLTAGES GENERATED IN THE IGNITION SYSTEM EXCITER CAN CAUSE SERIOUS INFURY TO PERSONNEL.
R THE APU BAT BUS - IGNITION (B3-S11) CIRCUIT
RR BREAKER SHOULD BE OPENED AND APU POWER HARNESS JP1
RR CONNECTOR DISCONNECTED TO ASSURE REMOVAL OF POWER
RR FROM THE EXCITER. ALWAYS WAIT AT LEAST SIX
R MINUTES FOR VOLTAGES IN THE EXCITER TO BLEED DOWN
R BEFORE WORKING ON THE HIGH TENSION PORTION OF THE
R IGNITION SYSTEM. DISCONNECT AND GROUND OUT THE
R HIGH TENSION IGNITION CABLE AT THE IGNITER WHEN
R REMOVING THE EXCITER OR AN IGNITER.

R (1) Ensure that the MASTER POWER switch on the APU CONTROL
R panel, zone 215, is in the OFF position. Attach a
R MAINTENANCE-IN-PROGRESS tag to the APU CONTROL panel.

R (2) On the Flight Engineer/Second Officers circuit breaker
R panel CB3, zone 215, open and tag APU POWER circuit
R breakers (B9 through B14) and IGNITION circuit breaker
R (S11).

R (3) Open APU compartment access doors.

(4) Disconnect APU power harness connector JP1 at the APU compartment forward bulkhead.

(5) Disconnect the igniter cables at the igniters and discharge any stored charge in exciter by grounding the cable terminal to the engine.

NOTE: If ignition exciter is being replaced due to faulty ignition system, it is recommended that both igniters be removed (Ref. 49-41-01) and inspected for general condition (Ref. 49-41-01, Inspection and Check).

(6) Lightly spray insulated ends of igniter cable terminals with fluorocarbon dry spray lubricant and reconnect cables to igniters. Tighten cable coupling nuts fingertight plus 45 degrees, and install lock-wire.

(7) Disconnect APU power harness connector JP6 at the top of the ignition exciter.

(8) Disconnect the two igniter cables at the bottom of the exciter.

(9) Remove the exciter support fasteners and remove the exciter.

B. Installation

(1) Observe WARNING in Step 3A.

(2) Verify that MASTER POWER switch on the APU CONTROL panel is in the OFF position and that the circuit breakers opened in Steps 3A(2) are open.

(3) Position the ignition exciter on the exciter support bracket and secure exciter to bracket with four attach bolts and washers. Tighten the exciter fastener nuts 24 to 36 lb in.

(4) Connect APU power harness connector JP6 and install lock-wire.

(5) Lightly spray the rubber insulated ends of the igniter cable terminals with fluorcarbon dry-spray lubricant and connect cables to exciter. Tighten cable coupling nuts fingertight plus 45 degrees and add lock-wire.

(6) Reconnect APU power harness connector JP1 at the APU compartment forward bulkhead.

R (7) Remove tag and close circuit breakers opened in Step
R 3A(2).

R (8) Remove the MAINTENANCE-IN-PROGRESS tag at the APU
R CONTROL panel.

R (9) Start the APU and verify light off (rise in TGT) at
R approximately 10% NG (Ref. 49-00-01).

R (10) Close APU access doors and swing fluid catcher aft
R against scupper on access door.

IGNITION EXCITER - ADJUSTMENT AND TEST

1. General

The following procedure may be used to functionally test both an installed ignition exciter and the igniter plugs.

2. Referenced Procedure

49-41-01 Igniter Plug - Removal and Installation

3. Equipment and Materials

Test Box, local manufacture (2 required to test both igniters simultaneously, Ref. Fig. 501)

Lock-wire, Fed Spec QQ-W-390, 0.032 inch diameter, or equivalent

4. Adjustment/Test

A. Operational Check

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag FIREWALL SHUTOFF - PRIM and SEC (S7 and S8) circuit breakers.

(2) Attach MAINTENANCE-IN-PROGRESS tag to APU CONTROL panel.

(3) Open APU compartment access doors.

(4) Disconnect APU power harness connectors JS6 and JS7 at automatic fuel shutoff valve assembly solenoids.

R WARNING: RESIDUAL VOLTAGE IN THE IGNITION EXCITER IS APPLIED TO THE IGNITER CABLES AND CAN BE DANGEROUSLY HIGH. BE CERTAIN THAT THE IGNITION SYSTEM HAS BEEN INOPERATIVE FOR AT LEAST 6 MINUTES BEFORE DISCONNECTING AN IGNITER CABLE COUPLING NUT. ALWAYS GROUND THE CABLE TERMINAL TO THE ENGINE CASE IMMEDIATELY AFTER DISCONNECTING IT FROM AN IGNITER.

(5) Disconnect igniter cables at both igniters. As each cable is disconnected, touch the cable terminal to the engine case to dissipate any residual voltage in the exciter.

(6) Remove both igniter plugs (Ref. 49-41-02).

(7) Install igniter plugs in test boxes and reconnect respective igniter cables to the igniters.

(8) Ground test boxes to APU engine.

R CAUTION: KEEP HANDS CLEAR OF IGNITERS.

(9) Turn on APU MASTER POWER switch and depress APU START switch. As engine speed rises above approximately 10% NG, verify that sparks produced at each igniter are brilliant and consistent.

R (10) Depress APU stop switch. When DOORS IN TRANSIT light
R goes out, turn off APU MASTER POWER switch.

(11) Wait approximately 10 minutes, then disconnect the igniter cables from the igniters, grounding each cable terminal as it is disconnected.

(12) Remove igniter plugs from test boxes.

(13) Reinstall igniters, using new gasket and install lock-wire.

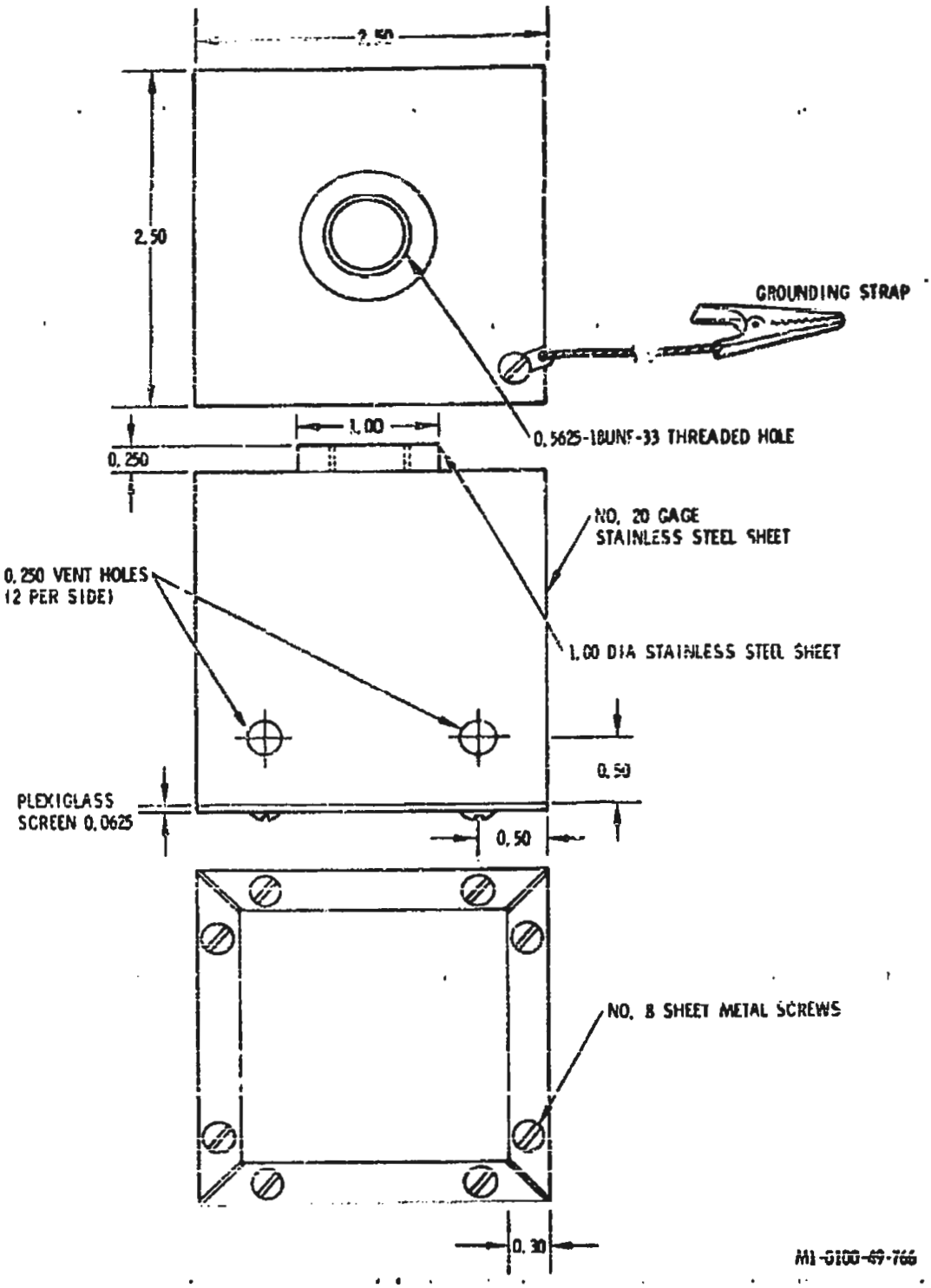
(14) Reconnect igniter cables to igniters. Tighten coupling nuts fingertight plus 45 degrees. Install lock-wire.

(15) Reconnect power wiring harness connectors JS6 and JS7 to automatic fuel shutoff valve solenoids. (JS7 connector attaches to fuel bypass valve (aft) solenoid). Install lock-wire.

(16) Close APU compartment access door and swing fluid catcher aft against scupper on APU access door.

(17) Remove tags and close circuit breakers opened in Step 4A(1).

(18) Remove MAINTENANCE-IN-PROGRESS tag at APU CONTROL panel.



Igniter Plug Test Box
Figure 501

EFFECTIVITY: ALL

001B

ENGINE STARTER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Current Limiter (Ref. WDM 24-32-04)

Drive Spline Lubricant, Plastilube No. 3, or equivalent (Plastilube No. 3 is procurable from Warren Refining Division, Parr Inc., 5151 Denison Ave, Cleveland, Ohio 44102)

R Methyl-Ethyl-Ketone-TT-M-261 or equivalent

Sealant, RTV 154 (General Electric Co.), or equivalent

Starter Pad Gasket (Ref. Fig. 401)

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Petrolatum Graphite, MIL-T-5544, or equivalent

Strontium Chromate, A-136-2CP (Andrew Brown Co. Irving, Texas), or equivalent

R Torque Wrench

2. Referenced Procedure

R	6-40-00	Exterior Access Doors and Panels
	24-32-03	Nickel-Cadmium Battery - Removal and Installation
	24-41-00	External Power/Ground Service System - Maintenance Practices
	49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation (Type C3632B-2 Starter)

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel C83, zone 215, open and tag APU POWER circuit breakers (B9) through (B17).

(2) Attach MAINTENANCE IN PROGRESS tag to APU CONTROL panel.

(3) Gain access to APU starter by opening APU compartment
R doors 319AL and 319BR (Ref. 6-40-00).

(4) If installed, remove starter terminal cover (Ref. Fig. 401). Disconnect starter harness from starter terminal studs. If starter harness does not have insulating boots over terminal lugs, cover each exposed lug with insulation. Keep lugs well separated.

NOTE: If replacement starter is not being installed at this time, stow disconnected end of starter harness.

CAUTION: WHEN REMOVING STARTER, EXERCISE CARE NOT TO DAMAGE THE STARTER SHAFT SPLINES WHICH EXTEND 1.25 INCH BEYOND THE STARTER MOUNTING FLANGE.

(5) Remove starter attach nuts and washers. If a starter clutch is installed, the two upper starter attachments will be Allen head screws. Remove screws.

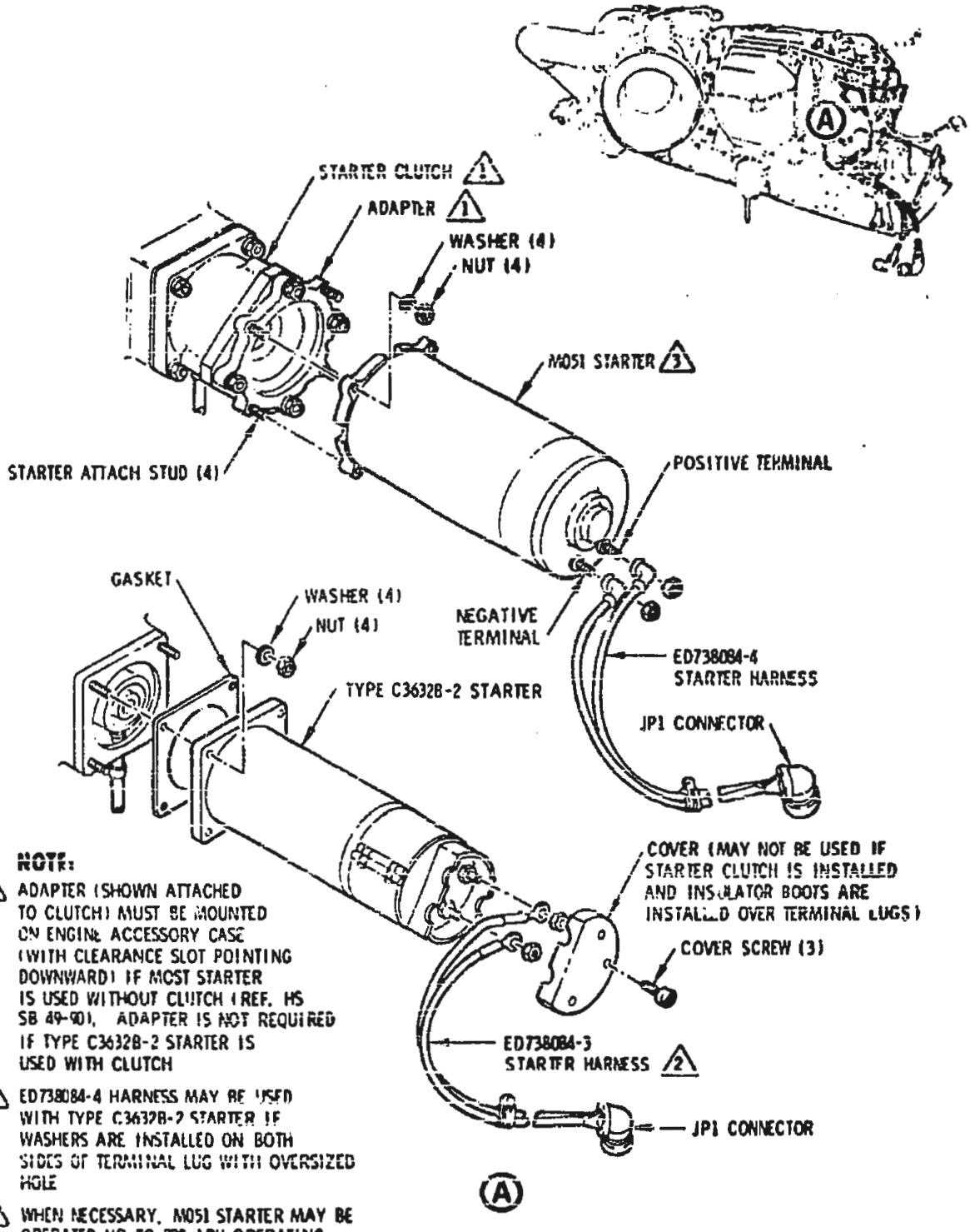
(6) Separate starter from mounting studs on engine accessory case (or starter clutch, if installed).

(7) Check starter drive pad cavity for an accumulation of oil higher than the drain tube standpipe. If there is excessive oil in the cavity area, the oil drain line to the drip tank may be clogged and should be checked and cleared.

B. Installation

(1) If starter is being mounted on a starter clutch, coat the two starter mounting pad studs and two Allen-head starter attached screws with petrolatum graphite. Coat two washers with a film of wet strontium chromate and place one washer under the head of each Allen-head screw (Ref. Fig. 401).

(2) Coat starter drive splines with a film of Plastilube No. 3, or equivalent drive spline lubricant.



NOTE:

1. ADAPTER (SHOWN ATTACHED TO CLUTCH) MUST BE MOUNTED ON ENGINE ACCESSORY CASE (WITH CLEARANCE SLOT POINTING DOWNWARD) IF MOST STARTER IS USED WITHOUT CLUTCH (REF. HS SB 49-901). ADAPTER IS NOT REQUIRED IF TYPE C3632B-2 STARTER IS USED WITH CLUTCH
2. ED738084-4 HARNESS MAY BE USED WITH TYPE C3632B-2 STARTER IF WASHERS ARE INSTALLED ON BOTH SIDES OF TERMINAL LUG WITH OVERSIZED HOLE
3. WHEN NECESSARY, M05I STARTER MAY BE OPERATED UP TO 200 APU OPERATING HOURS WITHOUT A CLUTCH

MI-0003-49-127

R R Engine Starter - Removal and Installation
Figure 401

EFFECTIVITY: ALL

0018

R R R R WARNING: USE METHYL-ETHYL-KETONE IN WELL VENTILATED AREA. AVOID FLUID CONTACT WITH SKIN AND EYES. PROLONGED EXPOSURE MAY RESULT IN SKIN IRRITATION. (3) Before installing replacement starter, verify that the starter drive housing attach bolt heads have been coated with sealant. If not, clean the bolt heads and surrounding area with methyl-ethyl-ketone (MEK), or equivalent solvent, and apply a film of RTV 154, or equivalent sealant, to the bolt heads.

(4) If starter is being installed on an APU without a starter clutch, install new gasket on engine accessory case pad (Ref. Fig. 401) and coat engine pad studs with a film of petrolatum graphite.

(5) Remove wiring harness terminal cover.

CAUTION: WHEN INSTALLING STARTER, EXERCISE CARE NOT TO NICK THE SPLINES ON THE STARTER SHAFT WHICH PROJECTS 1.25 INCHES BEYOND THE STARTER HOUSING.

TAKE CARE TO AVOID STRIKING THE SPLINED END OF THE ENGINE STARTER SHAFT AS ENOUGH SHOCK COULD BE TRANSMITTED THROUGH THE SHAFT TO FRACTURE THE CARBON FACE SEAL AT THE OPPOSITE END OR THE SHAFT.

(6) Place starter in position on mounting pad studs and carefully engage drive splines. If starter is being installed on a starter clutch, install two Allen-head starter attach screws with a washer under the head of each screw.

(7) Coat starter attach nut washers with wet strontium chromate. Install washers and nuts.

NOTE: Note running torque required to thread each self-locking nut on its respective attach screw or stud. Nut installation torque may be 6.5 to 60 lb in.

(8) When nuts are seated against the starter flange, alternately tighten each nut to a torque value 180 to 200 lb in. higher than the nut installation.

(9) Identify starter harness configuration as follows:

(a) P/N ED738084-3 harness is identified by part number on harness name tag and two starter terminal lugs having identical size terminal stud

holes. This harness can be used only with a type C36328-2 starter.

(b) P/N ED738084-4 harness is identified by part number on harness name tag and terminal boots over the terminal stud lugs. The negative terminal lug has a larger terminal stud hole than the positive lug to permit mating with the polarized positive and negative terminal studs on an M051 starter. The harness may be used with a type C36328-2 starter without regard to polarity if a washer is used on both sides of the lug having the larger hole.

(10) If a P/N ED738084-3 starter harness is installed, and there is sufficient clearance between starter and APU compartment wall for the terminal cover, place the harness lugs on the terminal studs (without regard to polarity) and install the terminal stud nuts. Tighten terminal stud nuts to a torque of 45 to 55 lb in. and install the terminal cover. Tighten cover attach screws 15 to 20 lb in. and add lock-wire. If there is insufficient clearance for cover installation, install a terminal boot on each wire and connect harness to terminal studs as above. Position the terminal boots over the terminals. Do not install the terminal cover.

(11) If a P/N ED738084-4 starter harness is installed and there is sufficient clearance between starter and APU compartment wall for the terminal cover, remove the terminal lug boots (if installed) and place the harness lugs on the terminal studs (without regard to polarity) with a washer on both sides of the lug having the oversized hole. Install terminal stud nuts and tighten nuts to a torque of 45 to 55 lb in. Install terminal cover. Tighten cover screws 15 to 20 lb in. and add lock-wire. If there is insufficient clearance for the cover, connect the harness to the starter as above with terminal boots installed and position the boots over the terminals. Do not install the cover.

R (12) Close APU compartment door 319AL and 319BR (Ref. R 6-40-00).

R (13) Replace starter current limiter (Ref. Para 5)

R NOTE: The 225-amp current limiter in the APU starter R power circuit is subject to subsequent failure R after having been excessively heated by starter R current. It is therefore recommended that a new R current limiter be installed whenever the APU R starter is replaced. A spare current limiter is

R R R R R mounted in the battery power equipment box for use when one is not readily available from local stock. If used, a new spare limiter should be installed in the box at the convenient opportunity.

R R R (14) On Flight Engineer/Second Officers aft circuit breaker panel CB3 remove tag and close circuit breakers (B9) through (B17) opened in Step 3A(1).

R (15) Remove MAINTENANCE IN PROGRESS tag at APU CONTROL panel and start APU to check out starter operation (Ref. 49-00-01).

4. Removal/Installation (M051 Starter)

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers (B9) through (B17).

(2) Attach MAINTENANCE IN PROGRESS tag to APU CONTROL panel.

R (3) Gain access to APU starter by opening APU compartment access doors 319AL and 319BR (Ref. 6-40-00).

(4) Slip back starter terminal boots and disconnect starter harness from starter terminal studs (Ref. Fig. 401).

NOTE: If replacement starter is not installed at this time, be certain boots are slipped over exposed harness lugs. Tape boots closed and stow disconnected end of harness.

CAUTION: WHEN REMOVING STARTER, EXERCISE CARE TO PREVENT DAMAGING THE SPLINED STARTER SHAFT WHICH PROJECTS BEYOND THE STARTER MOUNTING FLANGE.

(5) Remove starter housing to adapter attach nuts, screws, and washers.

NOTE: Remove two lower starter attach nuts first. Hold starter against mounting flange when removing two upper nuts. Starter weighs approximately 24 lbs.

(6) Remove starter.

(7) If APU is not equipped with a starter clutch, check the starter drive pad cavity for an accumulation of oil higher than the drain tube standpipe. If there is an excess of oil in the cavity area, the drain line to the drip tank may be clogged and should be cleared.

B. Installation

NOTE: If necessary, M051 Starter may be operated up to 200 APU operating hours without a clutch.

(1) Coat the four starter adapter studs with a film of petrolatum graphite.

CAUTION: WHEN INSTALLING STARTER, EXERCISE CARE TO PREVENT NICKING THE SPLINED STARTER SHAFT. AVOID STRIKING THE ENGINE STARTER SHAFT AS ENOUGH SHOCK COULD BE TRANSMITTED THROUGH THE SHAFT TO DAMAGE THE CARBON FACE SEAL AT THE OPPOSITE END OF THE SHAFT.

(2) Apply a film of Plastilube No. 3, or equivalent, lubricant, to the starter shaft splines.

(3) Mount starter in installed position on adapter studs and install the two upper attach screws (with washer under the head of each screw) and the attach washers and nuts. Note running torque (6.5 to 60 lb in.) required to install each fastener nut.

(4) When nuts are fully seated against the starter flange, alternately tighten each nut to a torque value 180 to 200 lb in. higher than the nut installation torque.

(5) Connect the starter harness lugs to the starter terminal studs. (Lug holes are sized to match the positive and negative terminal studs).

(6) Install terminal nuts and torque inner nut to 25 lb. in. and then, while holding inner nut stationery, torque the outer nut to 150 lb. in. Slide terminal
R boots over starter stud. (7) Close APU compartment
R access doors 319AL and 319BR (Ref. 6-40-00).

R (8) Replace starter current limiter (Ref. Para 5).

R NOTE: The 225-amp current limiter in the APU starter
R power circuit is subject to subsequent failure
R after having been excessively heated by starter
R current. It is therefore recommended that a new
R current limiter be installed whenever the APU
R starter is replaced. A spare current limiter is
R mounted in the battery power equipment box for

R use when one is not readily available from local
R stock. If used, a new spare limiter should be
R installed in the box at the next convenient
R opportunity.

R (9) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, remove tags and close circuit breakers (B9)
R through (B17) opened in Step 4A(1).

R (10) Remove MAINTENANCE IN PROGRESS tag and start APU to check out starter operation (Ref. 49-00-01).

5. Removal/Installation (Starter Current Limiter)

A. Removal

(1) Remove external electrical power (Ref. 24-41-00).

(2) In the MESC, zone 137, disconnect the aircraft battery (Ref. 24-32-03).

(3) Remove cover from battery power equipment box.

(4) Loosen 225-amp current limiter retaining nuts and remove the limiter by disengaging it from the 28V dc jumper support studs.

B. Installation

(1) Engage tangs of 225-amp current limiter to the 28V dc jumper support studs and tighten the limiter retaining nuts.

(2) If spare limiter stored in the box is used, verify that the spare limiter retaining nuts are secure on the studs.

(3) Install battery power box cover.

(4) Connect aircraft battery (Ref. 24-32-03).

APU STARTER RELAY - REMOVAL AND INSTALLATION

1. Referenced Procedures

24-32-03	Nickel-Cadmium Battery - Removal and Installation
49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test

2. Removal/Installation

A. Removal

R (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU BAT BUS - CONT PWR (S12) circuit breaker

R (2) In mid electrical service center, zone 137, disconnect battery (Ref. 24-32-03).

R (3) Remove cover from battery power equipment box assembly, zone 137, (Ref. Fig. 401).

R (4) Tag and disconnect battery power bus bar and control wiring from APU STARTER RELAY.

R (5) Remove nuts attaching relay to box and remove relay.

B. Installation

R (1) Verify that circuit breaker (S12) opened in Step 2A(1) is open and tagged.

R (2) Install APU STARTER RELAY with attaching nuts.

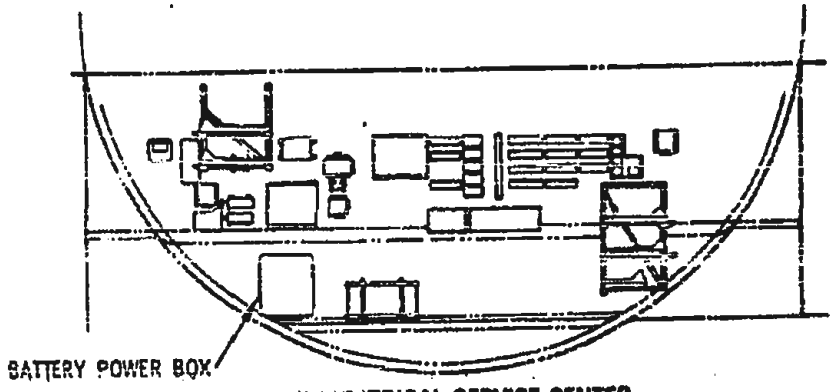
R (3) Connect battery power bus bar and control wiring to relay and remove tags.

R (4) Close cover on battery power equipment box.

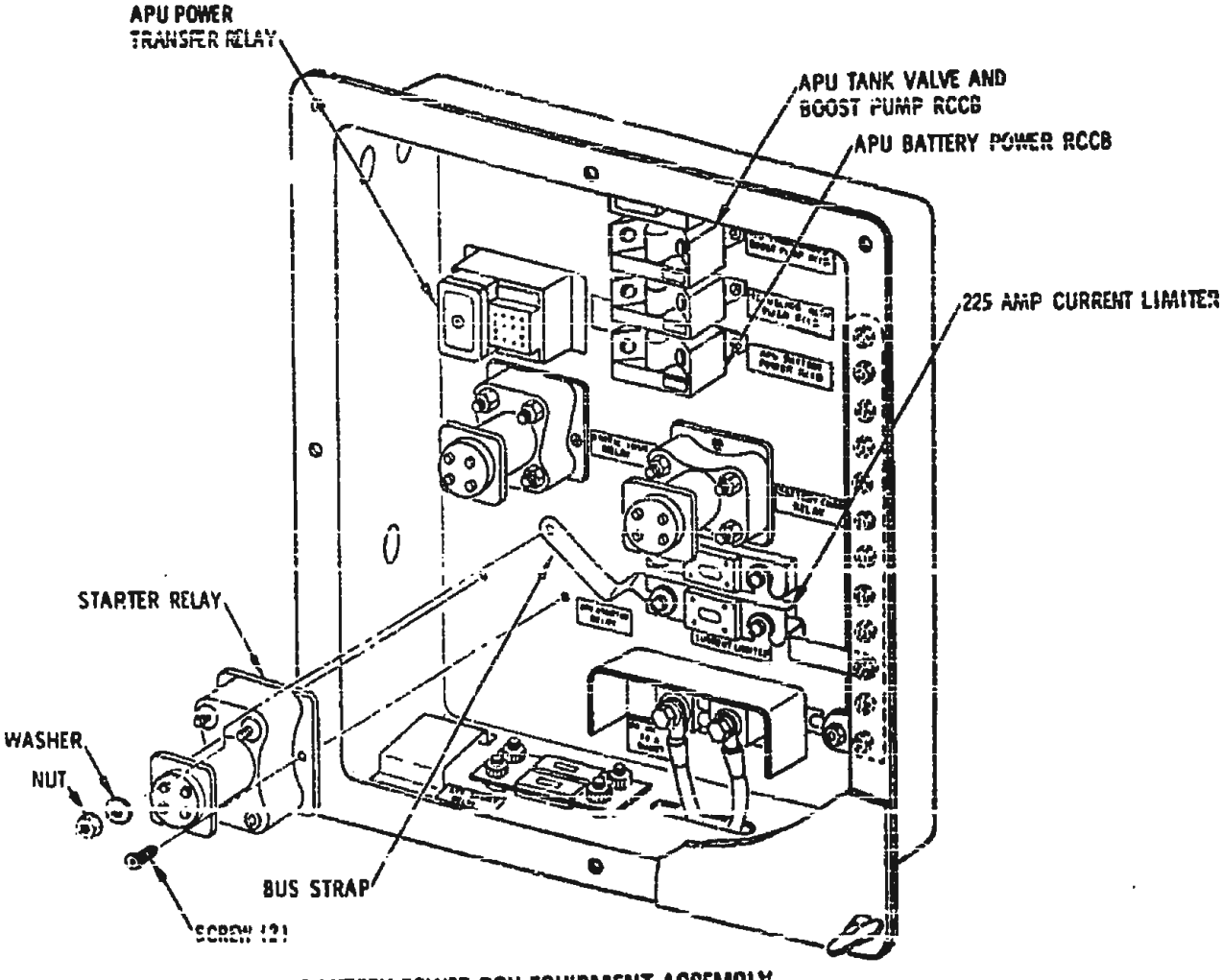
R (5) Connect aircraft battery (Ref. 24-32-03).

R (6) On Flight Engineer/Second Officers aft circuit breaker panel CB3 remove tag and close APU BAT BUS-CONT PWR (S12) circuit breaker opened in Step 2A(1).

R (7) Operate APU to check operation of APU starting system (Ref. 49-00-01).



MID ELECTRICAL SERVICE CENTER
VIEW LOOKING AFT



BATTERY POWER BOX EQUIPMENT ASSEMBLY

MI-0001-49-007

R APU STARTER RELAY - Removal and Installation
R Figure 401

APU STARTER CLUTCH - REMOVAL AND INSTALLATION

1. Equipment and Materials

Drive Spline Lubricant, Plastilube No. 3, or equivalent (Plastilube No. 3 is procurable from Warren Refining Division, Parr Inc., 5151 Denison Ave, Cleveland, Ohio 44102)

Gasket (Ref. Fig. 401)

Petrolatum Graphite, MIL-T-5544, or equivalent

Strontium Chromate, A-136-2CP (Andrew Brown Co, Irving, Texas) or equivalent

2. Referenced Procedures

12-12-41	Auxiliary Power Unit - Oil Replenishing
49-21-01	APU Gas Turbine Engine - Servicing
49-41-04	Engine Starter - Removal and Installation

3. Removal/Installation

A. Removal

(1) Remove APU starter (Ref. 49-41-04).

(2) Remove clutch attach nuts and washers (Ref. Fig. 401).

(3) Remove clutch.

(4) Discard clutch to engine pad gasket.

NOTE: Check starter drive pad cavity for an accumulation of oil higher than the drain tube standpipe. If there is excessive oil in the cavity area, check the drain tube to the drip tank for blockage.

(5) Remove starter mount adapter (if installed).

B. Installation

CR CAUTION: ALL CLUTCHES SHIPPED FROM MCI HAVE BEEN DRAINED OF
CR OIL AND MUST BE SERVICED PER (1) AND (9) BELOW
CR PRIOR TO OPERATING THE APU.

(1) Remove clutch oil quantity indicator and check oil quantity. If clutch contains no oil or oil is below hole in indicator dipstick, add same type oil as used in APU. On the bench with the clutch in a horizontal position the oil level must be just high enough to cover the hole in the indicator dipstick.

(2) Install new gasket on engine pad (Ref. Fig. 401).

(3) Apply a film of petrolatum graphite on the engine pad studs.

(4) Apply a wet film of strontium chromate to the clutch attach nut washers.

(5) Coat the clutch input and output drive shaft splines with Plastilube No. 3, or equivalent lubricant.

(6) Mount clutch on the engine pad studs and install the clutch attach washers and nuts. Record torque (6.5 to 60 lb in.) required to thread each nut on the studs.

(7) Tighten each clutch attach nut to a torque value 180 to 200 lb in. higher than the nut installation torque.

(8) Install the starter mount adapter (if required for M051 starter) as follows:

(a) Apply a film of petrolatum graphite to the two adapter mount studs and threaded portions of the two Allen-head adapter attach screws. Coat the adapter attach nut washers with a wet film of strontium chromate.

(b) Engage the adapter to the two studs on the clutch.

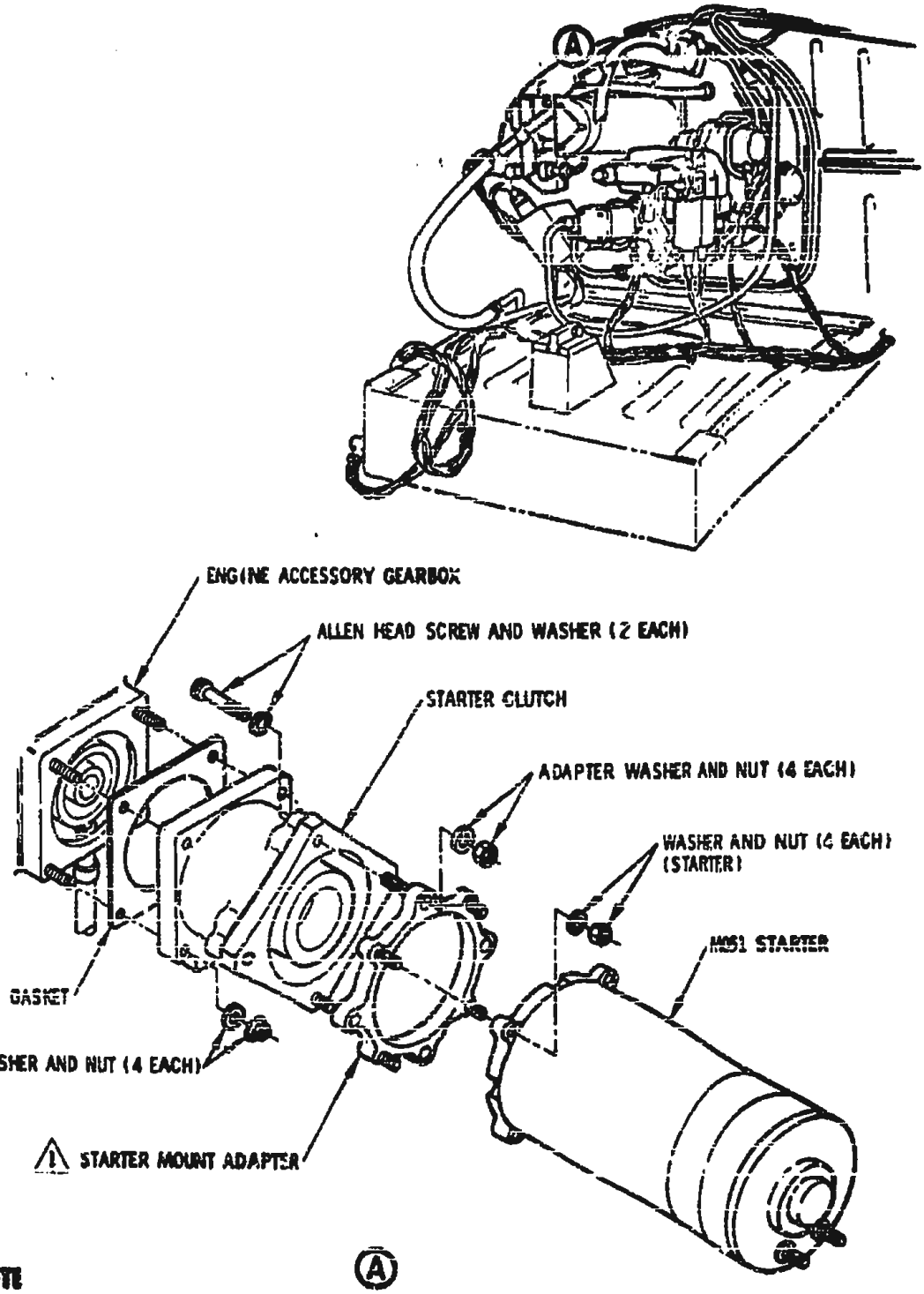
(c) Install one washer and nut on each stud.

(d) Place one washer under the head of each Allen-head screw and install screws using one washer under each attach nut.

(e) Record installation torque (6.5 to 60 lb in.) for each nut. When nuts are fully seated, tighten each nut to a torque 180 to 200 lb in. higher than the nut installation torque.

(9) Check clutch oil quantity and replenish as necessary. With the APU installed in the aircraft, clutch oil level should be 1/16 to 1/8 inch above the dipstick hole (Ref. 49-21-01 and 12-12-41).

(10) Install APU starter (Ref. 49-41-04).



APU Starter Clutch - Removal and Installation
Figure 401

AIR SYSTEMS - DESCRIPTION AND OPERATION

1. General

The APU supplies air for the pneumatic system and generates electrical power. The air system consists of a single-stage centrifugal compressor and the controls and valves to control the airflow.

2. Operation

Air is drawn into the compressor through an inlet in the side of the fuselage and a set of inlet guide vanes (Ref. Fig. 1). The inlet guide vanes are controlled by an electro-pneumatic-mechanical system. With the inlet guide vanes in the most closed position the load on the compressor is minimum; in the fully open position (maximum air flow), the compressor is subjected to the maximum load.

A pneumatically operated surge valve ensures that the compressor will always have a minumum flow output. The surge valve prevents compressor stall during sudden changes in airload.

The compressor output is fed to the aircraft systems through a bleed air check valve and a shutoff valve.

R 3. Load Hardware Gearbox

A. Description

R The load hardware gearbox (Ref. Fig. 2) consists of a gearbox, a load compressor, and a cooling fan.

The gearbox serves as a power distribution source to drive the load compressor, the cooling fan, and the electric generator. The gearbox consists of a magnesium housing, roller and ball bearings, pinion and bevel gears, and a reverse-locking clutch.

The load compressor is a single-stage centrifugal air compressor which is mounted directly on the output end of the main gearbox drive shaft. The load compressor housing uses aluminum alloy sheet metal and forged parts joined by welding. The inlet provides a bolt-on flange which supports the inlet guide vane assembly. The compressor (diffuser section) contains 22 vanes. The load compressor rotor is a forged aluminum alloy radial-type wheel with a separate inducer section. The wheel is attached to the drive shaft

by a spline adapter. Full containment of the compressor rotor is obtained by a double-wall design, which consists of a thin penetrable inner skin to entrap blade fragments, and a heavier outer wall to resist penetration.

The cooling fan is a seven-blade, mixed-flow fan. The cooling fan is made of cast aluminum encased in a moulded plastic housing which attaches directly to the gearbox.

B. Operation

Power is applied from the free turbine shaft, through a quill shaft, to the load compressor. Two ground bevel gears mesh and split the torque path so that power goes directly to the load compressor and the electric generator. The gears are lubricated by a jet of oil. The cooling fan shaft is spur-driven by an external gear that is integrally machined in the bevel gear. The fan shaft incorporates the reverse-rotation locking clutch assembly. All shaft assemblies in the gearbox are mounted on antifriction bearings.

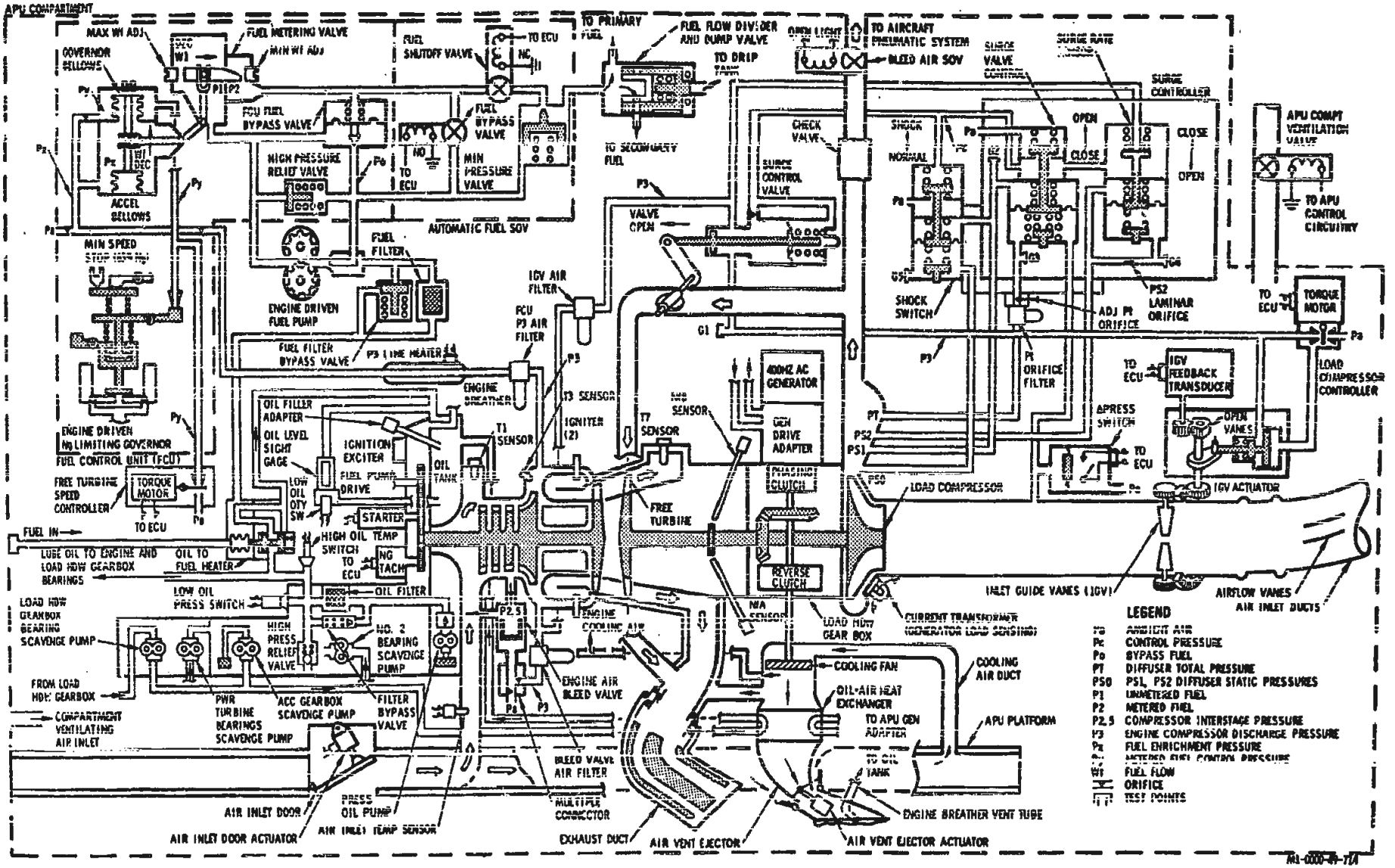
R The cooling fan provides air for APU compartment,
R ventilation, engine exhaust shroud cooling, and oil-to-air
R heat exchanger cooling to cool generator and engine oils.

R 4. Inlet Guide Vane Assembly

A. Description and Operation

R The inlet guide vane (IGV) assembly (Ref. Fig. 3) mounts on
R the load compressor housing on the aft end of the APU. In
R addition to the guide vanes and inlet housing, the IGV
R assembly includes an inlet guide vane feedback transducer,
R load compressor controller, and a pneumatically operated
R piston-type actuator.

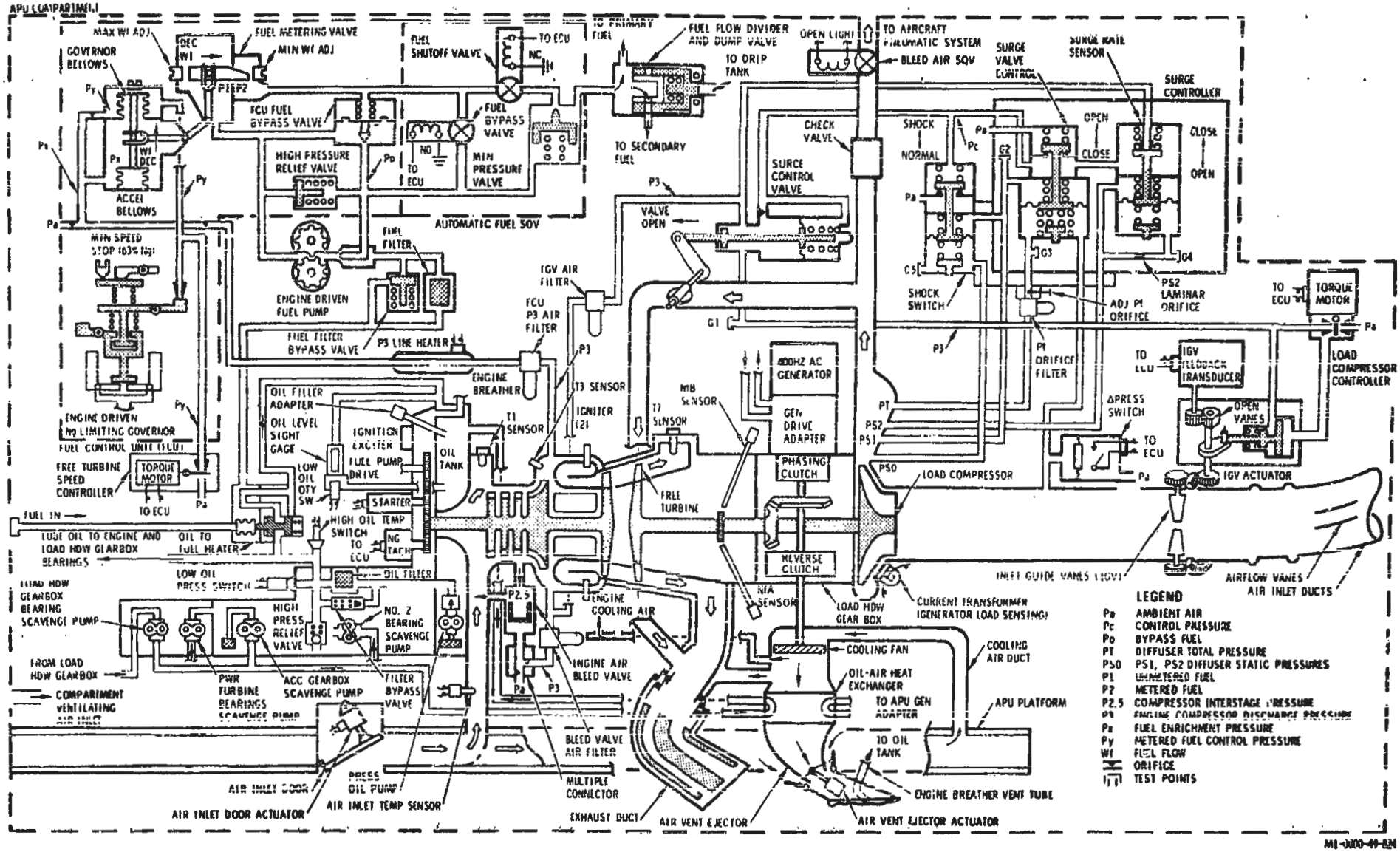
R The inlet guide vanes are never fully closed at any time.
R Pneumatic IGV servo pressure is supplied as P3 pressure from
R the engine. The piston type actuator positions the guide
R vanes according to this pneumatic pressure as modulated by
R the load compressor controller. The inlet guide vanes are
R normally positioned according to the required schedule by
R the ECU which signals the load compressor controller to
R establish the proper amount of P3 servo supply. As the
R inlet guide vanes move, a linkage system drives the
R potentiometer on the IGV feedback transducer which is biased
R as a voltage divider by the ECU, to signal that a new IGV
R null point is required (feedback loop).



R
R APU Power Plant Diagram
Figure 1

EFFECTIVITY: 001-031

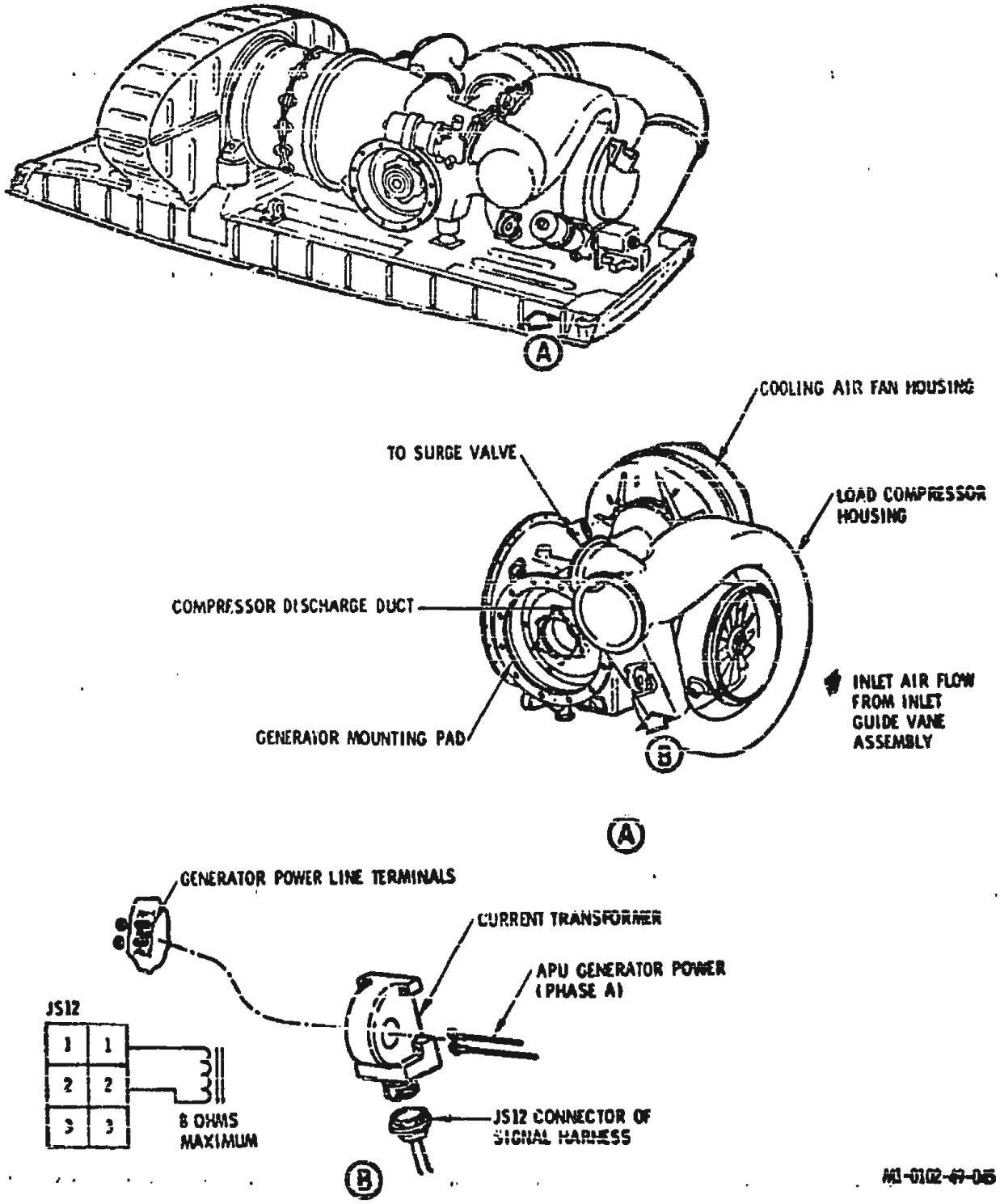
001B



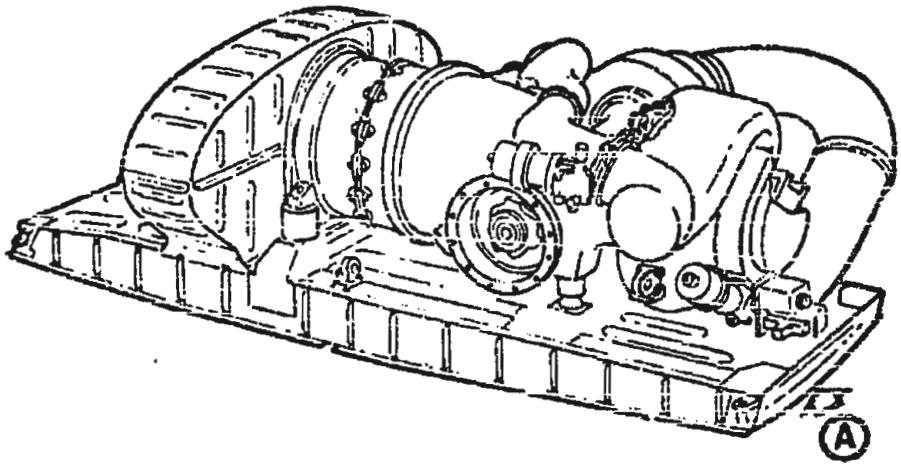
APU Power Plant Diagram
Figure 1

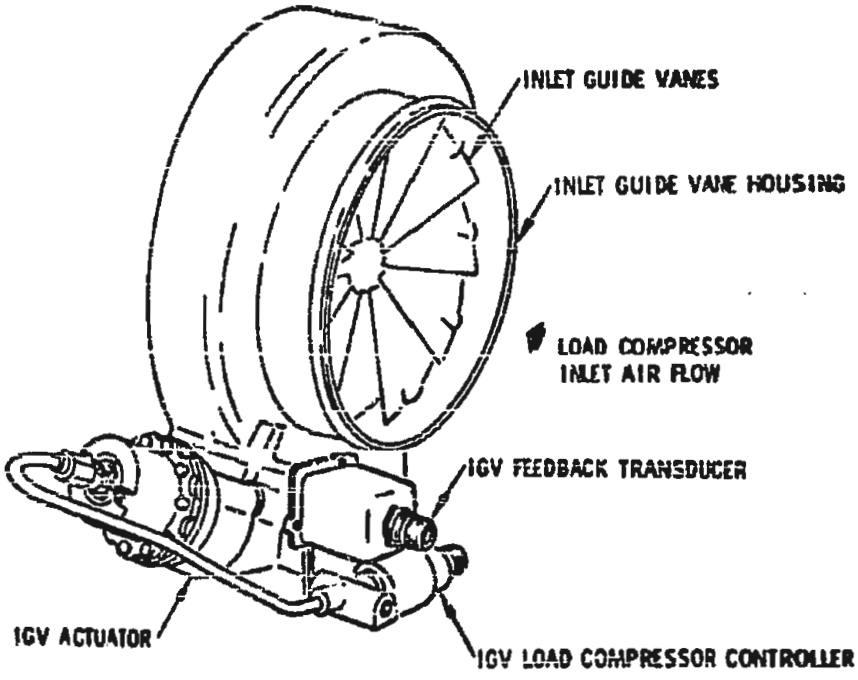
R
R
001B

EFFECTIVITY: 032-036



Load Hardware Gearbox
Figure 2





(A)

INLET GUIDE VANE ASSEMBLY

MI-0101-49-047

Inlet Guide Vane Assembly
Figure 3

5. Inlet Guide Vane Actuator

A. Description and Operation

The inlet guide vane actuator (Ref. Fig. 3), which is mounted on the case of the inlet guide vane assembly, is a pneumatically operated piston actuator. The housing and cover are extruded from aluminum alloy. The aluminum piston is fitted with two graphite-filled Teflon piston rings. Piston power is transmitted through a linkage system which positions the inlet guide vanes. The linkage system consists of a connecting link, an idler shaft, an actuator cam, and a gear segment which drives a feedback transducer.

A signal from the ECU provides current to the load compressor controller which furnishes controlled flow to the inlet guide vane actuator. The actuator imparts a mechanical force by linkages to a ring gear which is mounted in the load compressor inlet housing. The ring gear actuates slave bevel gears mounted on the inlet guide vanes. These inlet guide vanes move from a closed position to a fully open position according to desired airflow.

6. IGV Feedback Transducer

A. Description and Operation

The IGV feedback transducer (Ref. Fig. 3) mounts on the inlet guide vane assembly and consists of a variable resistor, a fixed current-limiting resistor (potentiometer) and an electrical connector within a protective cover.

The variable resistor is a rotary precision potentiometer which converts the mechanical position of the inlet guide vanes into an electrical voltage. The signal is fed to the ECU. Voltage of approximately 2.3 volts is an indication of closed guide vanes and 8V dc is an indication of full open guide vane position.

7. Load Compressor Controller

A. Description and Operation

The load compressor controller (Ref. Fig. 3) mounts on the inlet guide vane assembly and consists of an electro-magnetic torque motor and fluid amplifier. The torque motor consists of a coil magnet assembly and the fluid amplifier contains two nozzles which in conjunction with a movable flapper form two variable orifices.

Variations in the direct current electrical input from the ECU provide signals to the torque motor to position the flapper. Flapper position is proportional to the amount of current flow. A decrease in current moves the flapper against the ambient bleed orifice which provides higher pressure to the IGV actuator and moves the vanes toward the open position. An increase in current moves the flapper toward the servo supply orifice decreasing IGV actuator servo pressure and moving the vanes toward the closed position. The flapper is spring loaded toward the ambient bleed orifice, so that loss of electrical power will cause the inlet guide vanes to go full open.

8. Surge Valve Assembly

A. Description and Operation

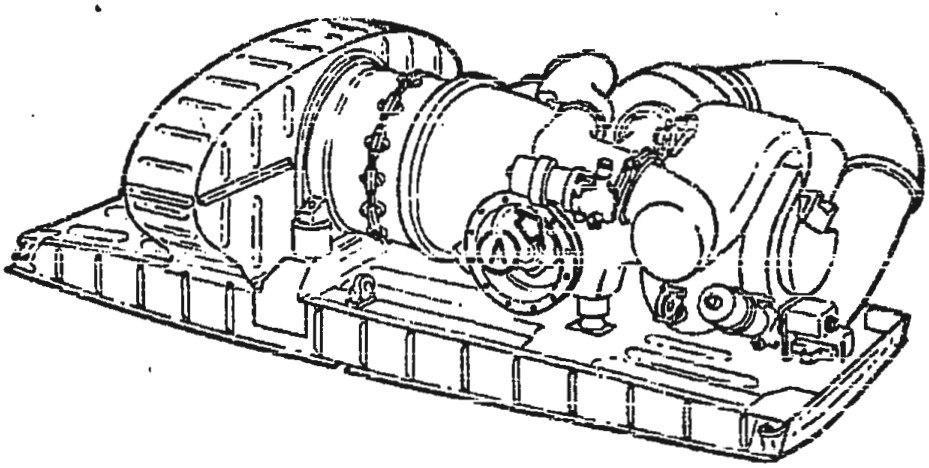
The surge valve (Ref. Fig. 4) mounts to the bypass outlet of the load compressor housing and consists of a 5.75-inch diameter butterfly valve mechanically linked to a pneumatic actuator containing a piston and a spring loaded diaphragm assembly. The piston is spring loaded in the open position. The filtered P3 air is supplied to oppose the spring loaded diaphragm to position the valve toward the proper position.

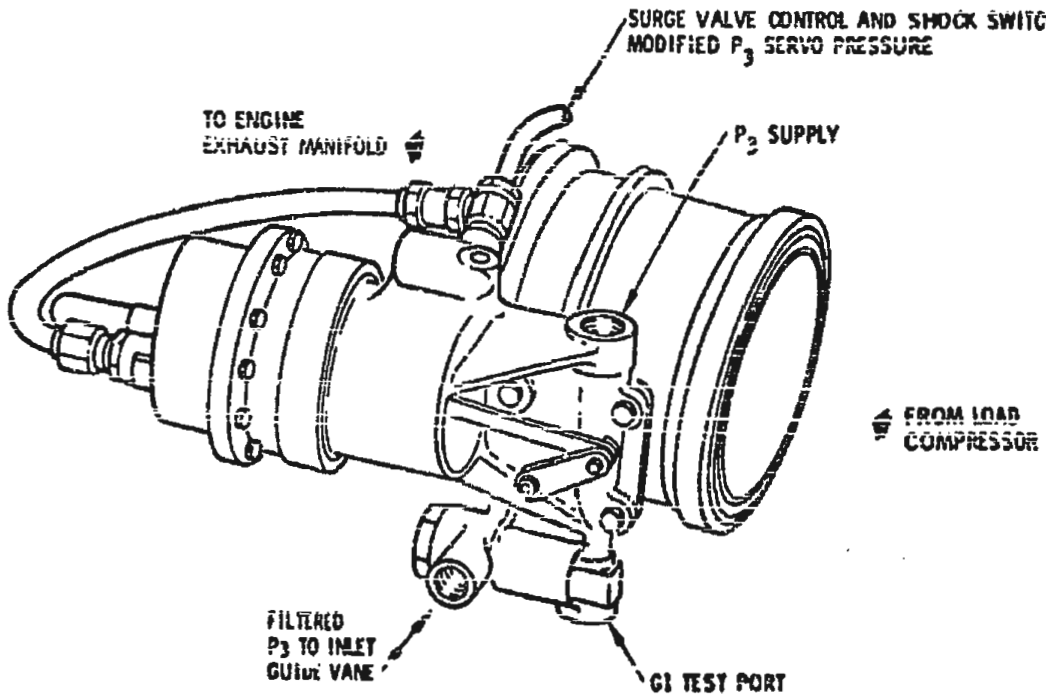
The surge valve controller normally regulates the surge valve position. APU engine compressor bleed air, P3, provides the force to hold the actuator in any position from 0 to 100 percent of actuator stroke. A modified P3 developed by a fixed orifice in the surge valve assembly and a variable orifice in the surge valve controller is sent to the spring loaded side of the surge valve. Filtered P3 pressure is applied directly to the other side of the diaphragm. When the surge valve controller senses decreases in aircraft pneumatic system demand, it moves its control poppet toward closed building up modified P3 servo and driving the valve toward open. If the shock switch actuates, the modified P3 servo pressure is dumped moving the surge valve toward closed. The open surge valve allows compressor output to flow into the engine exhaust.

9. Surge Valve Controller

A. Description and Operation

The surge valve controller (Ref. Fig. 5) is a flowing pneumatic, diaphragm type valve. The controller consists of an aluminum cast housing, a silicone-rubber Dacron fabric diaphragm, a poppet valve, and a filter. Ports are provided for two ground checkout outlets, an inlet guide vane





(A)
SURGE VALVE

M1-0101-49-050

Surge Valve Assembly
Figure 4

actuator variable orifice and surge valve actuator servo pressure hookups. The controller is located at the 12-o'clock position on the forward side of the load compressor housing. Access to the surge valve controller is gained when the APU is removed from the aircraft.

R The surge valve controller controls surge valve position
R when overboard air bleed is required to maintain total load
R compressor flow at a level which prevents load compressor
R surge. As a secondary function, it senses a reversal of the
R pressure ratio in the pipe diffuser and will hold the surge valve closed under this condition.

10. Load_Compressor_Discharge_Check_Valve

A. Description

The APU load compressor discharge check valve (Ref. Fig. 6) is a reverse flow check valve consisting of a double flanged, circular housing containing six pie-shaped segments (flappers). Each flapper is hinged at the check valve housing and spring-loaded to the closed position.

Six bumpers attached to internal surface of the valve housing serve as flapper open position stops.

A flow direction arrow is cast on the valve body to indicate correct valve orientation during installation. The valve is flange-mounted by V-band couplings in the load compressor discharge duct just aft (upstream) of the APU bleed air shutoff valve in zone 316.

B. Operation

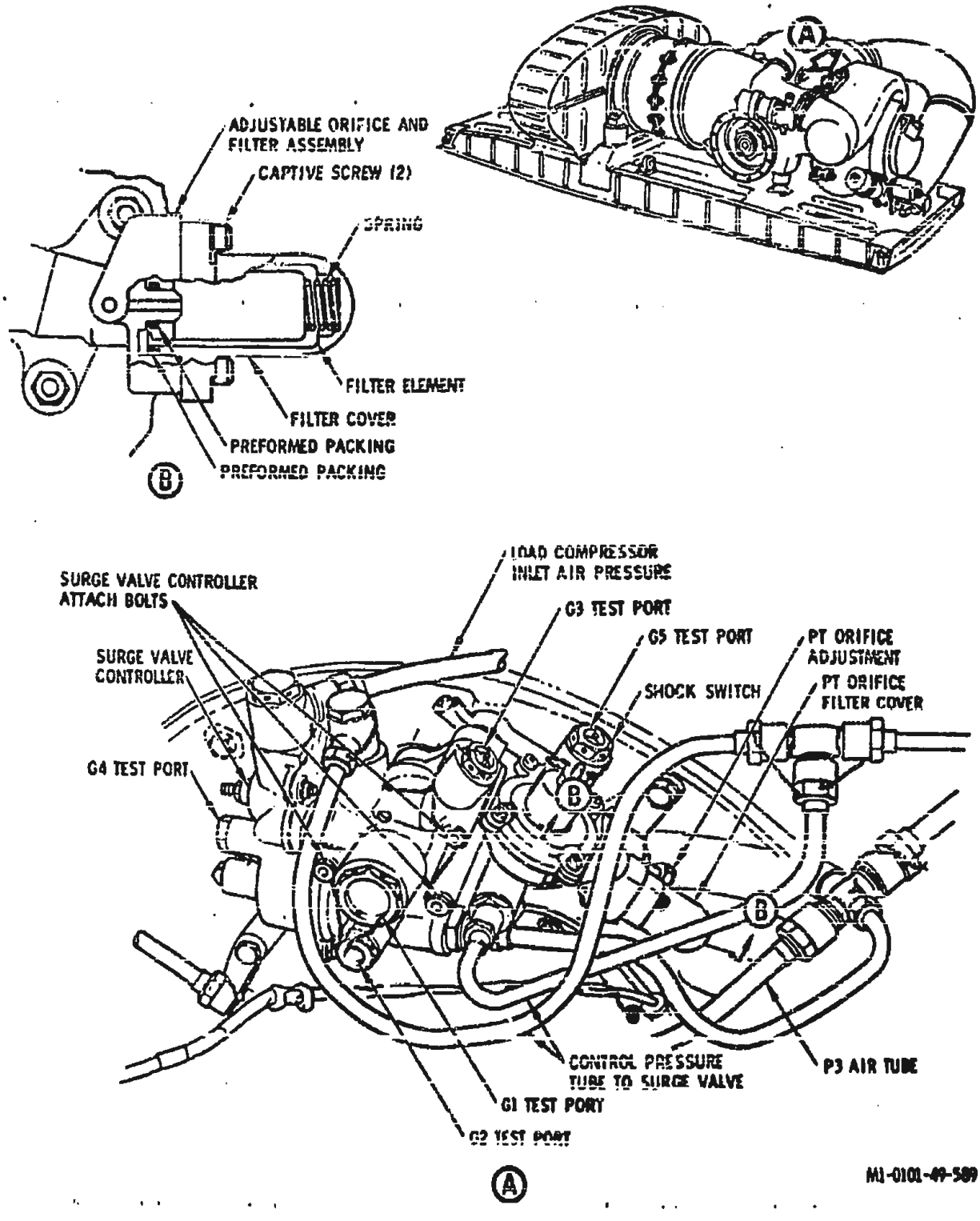
The discharge duct check valve prevents reverse flow of aircraft pneumatic system air toward the load compressor when the duct bleed air shutoff valve is open or has failed open.

11. Current_Transformer

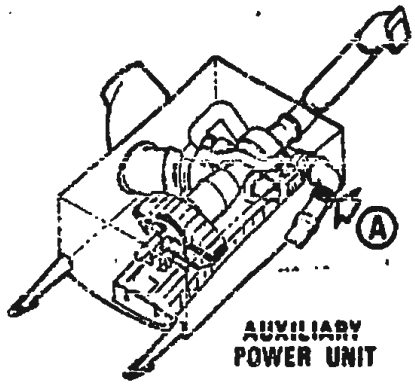
A. Description and Operation

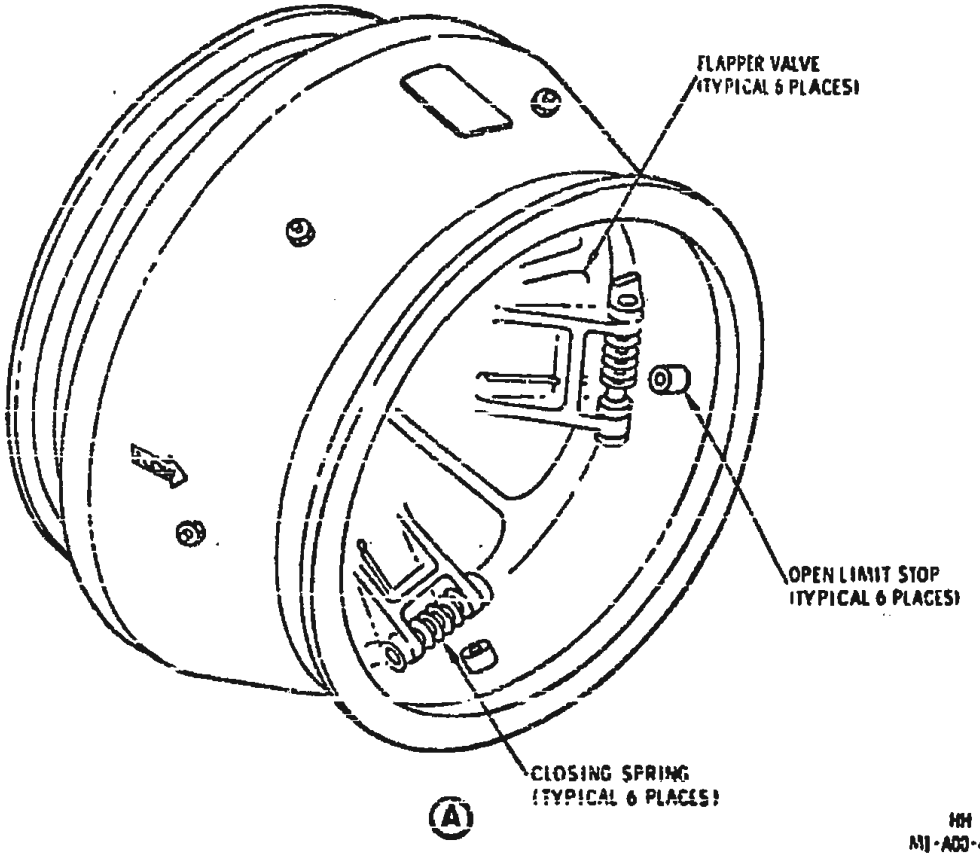
The current transformer (Ref. Fig. 2) is mounted on a bracket attached to the compressor housing.

Phase A wiring from the APU driven generator serves as the primary of the transformer. The transformer itself generates a current which is one-thousandth of the primary



Surge Valve Controller and Shock Switch
Figure 5





Load Compressor Discharge Check Valve
Figure 6

current when the transformer is loaded with a 20-ohm resistor.

Both phase A wires from the APU generator go through the center of the toroidal transformer. As current passes through, an electromagnetic field is developed around the wires which induces a current in the transformer. The flux density of the electromagnetic field determines the output of the transformer. The transformer provides an input to the transient control system to minimize APU speed deviations for aircraft electrical system load applications and removals.

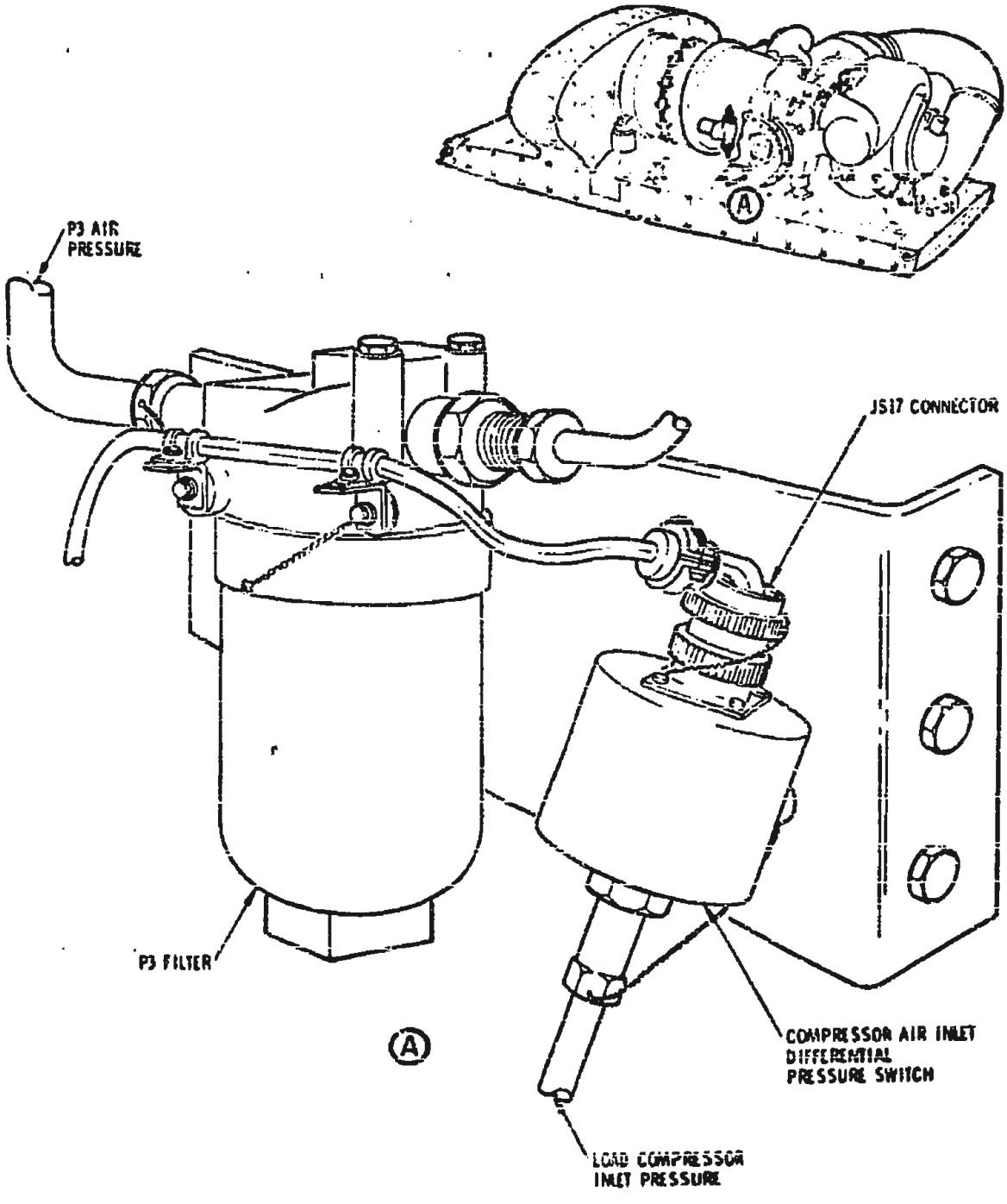
12. Inlet Flow Differential Pressure Switch

A. Description

To prevent load compressor damage which can be caused by foreign object blockage of the compressor air inlet flow, the APU compartment ambient to inlet air duct pressure is monitored by a differential pressure switch. The switch is mounted on the P3 air filter support bracket and connected by an external tube to a fitting exposed to the air inlet duct pressure between the compressor inlet guide vanes and compressor impeller (Ref. Fig. 7). The switch is wired in series with the air inlet door malfunction switch and when actuated will trigger two APU shutdown modes: one will shut down the APU by energizing an inlet flow shutdown relay in the aircraft APU control circuitry; a second mode opens the air inlet door malfunction switch circuit and initiates an ECU controlled shutdown. On APU's with HAM STD SB 49-79 and higher serial numbered APU's, the second shutdown mode is eliminated by a wiring modification which maintains door malfunction switch circuit continuity.

B. Operation

A differential pressure between APU compartment ambient and load compressor air inlet duct pressure of 4.5 to 5.3 psid will actuate the differential pressure switch. When this occurs, 28V dc voltage from ECU connector J1B, pin 18, applied through the switch and relaxed contacts of IGV MAX SEL relay (4961-K9) energizes INLET FLOW SHUTDOWN relay (4999-K13) which is electrically latched (Ref. 49-61-00). With the K13 relay energized, latching voltage to the APU stop relay (4961-K1) is removed and the APU control circuitry is commanded to a normal APU shutdown cycle. An INLET FLOW light on the APU control panel is activated by 28V dc continuous power through the energized INLET FLOW SHUTDOWN relay and provides a flight station indication of the reason for APU shutdown. Placing the APU master power



M1-0100-49-440

AFU Inlet Flow Differential Pressure Switch
Figure 7

R switch to off, then to on relaxes the INLET FLOW SHUTDOWN relay. This turns off the INLET FLOW light and permits an APU restart.

The inlet flow shutdown circuitry is inhibited during MAX MODE operation by IGV MAX SEL relay (4961-K9). When energized, one set of contacts in the K9 relay interrupts the INLET FLOW SHUTDOWN relay circuit and prevents an APU shutdown. A second set of contacts in the K9 relay maintains air inlet door malfunction switch circuit continuity and prevents an ECU initiated shutdown on APU's not incorporating the provisions of HAM STD SB 49-79.

The INLET FLOW light, if on, will remain on when MAX MODE is selected (either manually or during engine start). Dissipation of compressor inlet duct icing can then be
R verified when the light goes off.

R LOAD COMPRESSOR CONTROLLER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Preformed packing (Ref. Fig. 401)

R Lubricant, Dow Corning 44A, or equivalent (procured from Dow
R Corning Corp, Midland, Michigan)

R Lock-wire, Fed Spec QQ-W-390, 0.020-inch diameter, or equivalent

2. Referenced Procedure

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag circuit breakers B9
R through B17.

R (2) Open APU compartment access doors.

R (3) Disconnect JS 15 electrical connector at load
R compressor controller (Ref. Fig. 401).

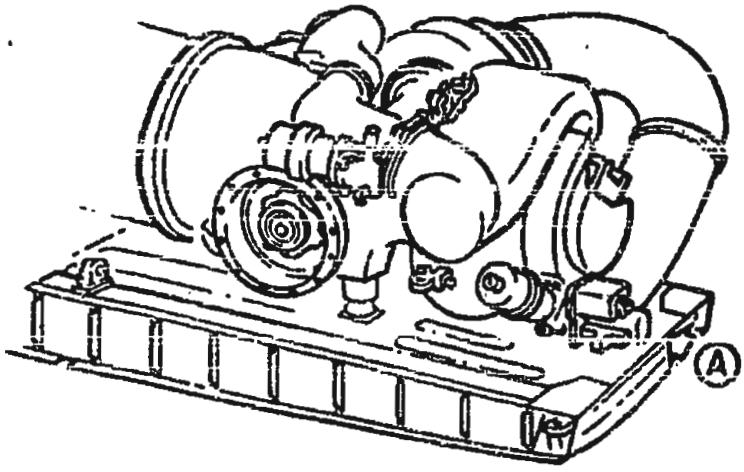
R (4) Back off tube nut at IGV actuator. Remove tube by
R gently pulling it out of the controller air outlet
R port. Discard the preformed packing located on the
R tube collar.

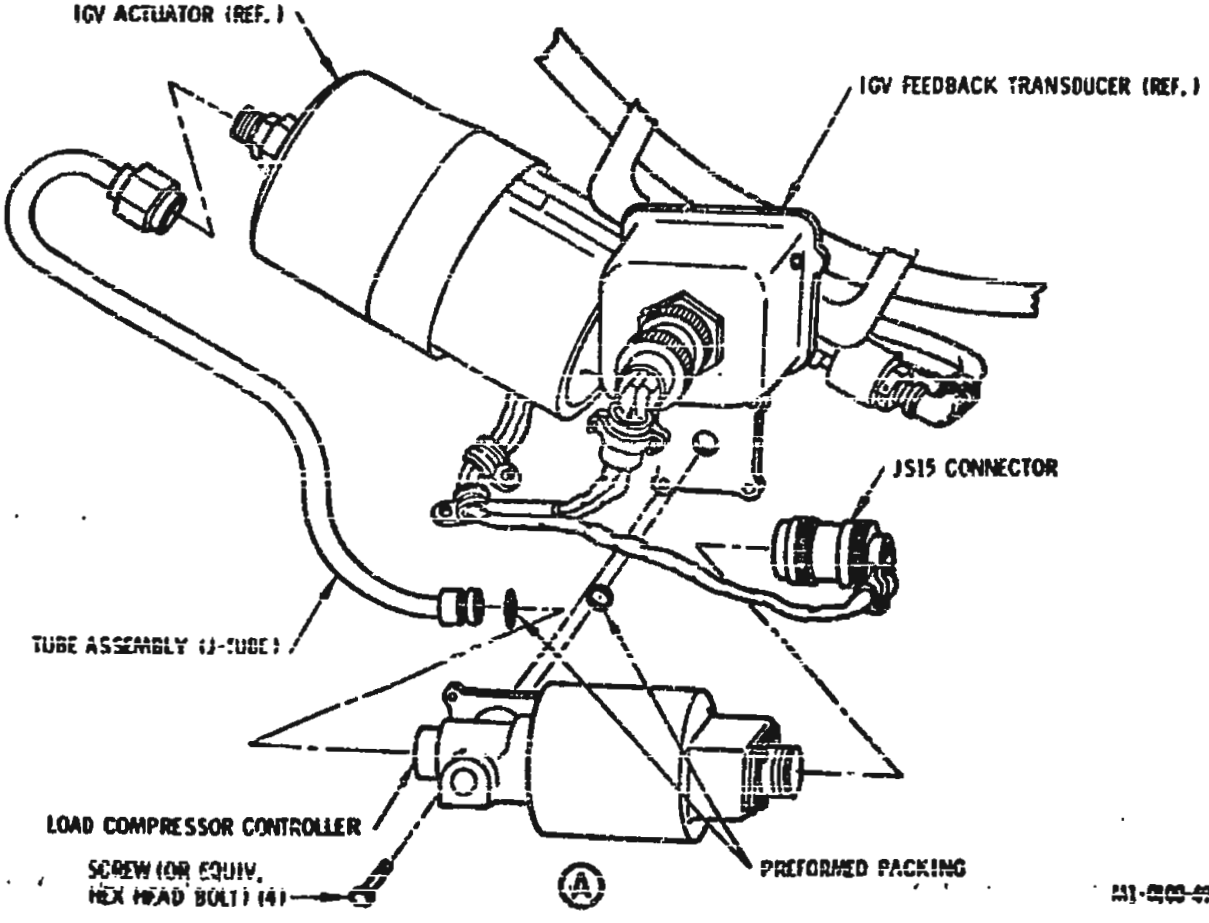
R (5) Remove four controller attach screws (or hex head bolts
R if used in lieu of machine screws) and separate
R controller from IGV actuator. Discard preformed
R packing on controller air inlet port.

B. Installation

R (1) Verify that circuit breakers opened in Step 3A(1) are
R open and tagged.

R (2) Lubricate new preformed packing with light film of Dow
R Corning No. 44, or equivalent, lubricant and install
R packing at controller air inlet port (Ref. Fig. 401).





R Load Compressor Controller Assembly - Removal and Installation
R Figure 401

(3) Mate controller to flange on IGV actuator and install four controller attach screws (or equivalent hex head bolts). Tighten attach screws to a torque of 25 to 30 lb in. higher than the screw running torque of 2 to 13 lb in.

(4) Apply light film of lubricant to preformed packing and install packing in collar groove on controller air outlet tube.

(5) Carefully insert collared end of tube in controller air outlet port and connect tube nut to IGV actuator. Tighten nut 1/6 to 1/3 turn (1/2 of hex flat) past the point where a sharp rise in tightening torque is noted. Lock-wire nut using 0.020-inch diameter wire.

CR (6) Connect JS15 electrical connector.

(7) Close APU compartment access doors.

(8) Remove tag and close circuit breakers opened in Step 3A(1).

(9) Operate APU in MIN MODE, NORM, and MAX MODE to check operation of load compressor controller (Ref. 49-00-01).

INLET GUIDE VANE ASSEMBLY - REMOVAL AND INSTALLATION

1. Equipment and Materials

Anti-Seize Compound, Petrolatum Graphite, MIL-T-5544, or equivalent

Petrolatum, Fed. Spec. VV-P-236, or equivalent (Dow Corning 44, procured from Dow Corning Corp, Midland, Mich., is approved equivalent)

Dissimilar Metal Lubricant, Strontium Chromate Epoxy Primer A-136-2CP, (Andrew Brown Co. Irving, Texas) or equivalent

Preformed packing (Ref. Fig. 401)

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal(1) Disconnect electrical connectors from inlet guide vane transducer and load compressor controller (Ref. Fig. 401).

(2) Disconnect the P3 air inlet tube at the inlet guide vane actuator body.

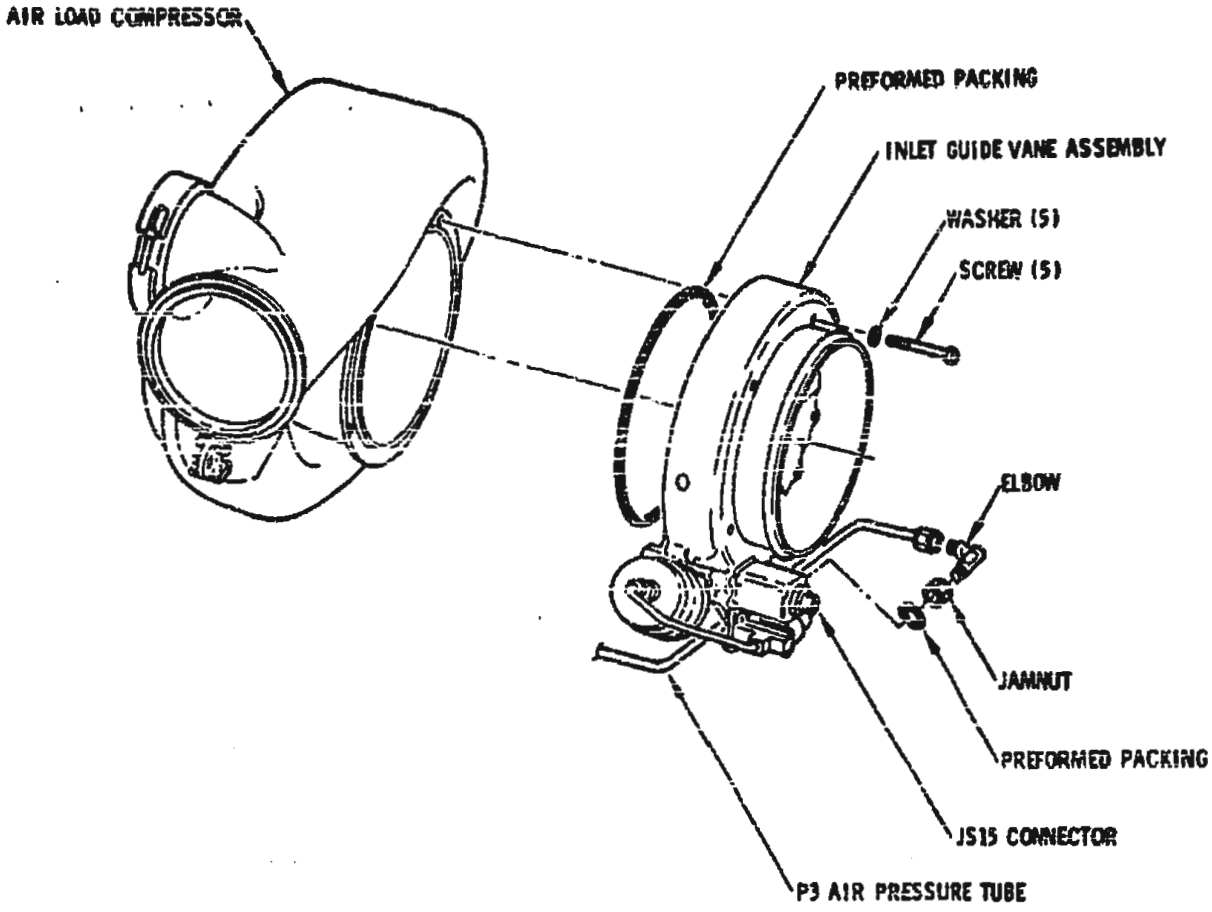
(3) Remove five inlet guide vane assembly attach screws and washers and separate the unit from the air load compressor.

(4) Discard preformed packing located between inlet guide vane assembly and air load compressor.

(5) Remove elbow and jamnut at inlet guide vane actuator body. Discard preformed packing and cap air inlet port.

B. Installation

(1) Coat new preformed packing with petrolatum or equivalent lubricant. Install jamnut and preformed packing on elbow (Ref. Fig. 401). Coat threads of elbow with petrolatum graphite and install in the inlet guide vane actuator air inlet port. Do not torque jamnut



M1-0102-49-155

R Inlet Guide Vane Assembly - Removal and Installation
R Figure 401

until orientation of elbow with air inlet tube is determined.

(2) Coat new preformed packing (air inlet guide vane to load compressor seal) with petrolatum or approved lubricant and place in position at the air inlet guide vane to load compressor housing interface.

(3) Coat five inlet guide vane assembly attach screw washers with strontium chromate and install on attach screws. Coat attach screws with petrolatum graphite.

(4) Support inlet guide vane actuator in its installed position and install the five attach screws. Alternately tighten each screw to a torque of 20 to 30 lb in. higher than the attach screw threading torque (2 to 18 lb in.).

(5) Connect air inlet tube to elbow fitting on inlet guide vane actuator. Tighten the elbow jamnut, then tighten tube B-nut to a torque of 180 to 200 lb in. Safety jamnut with 0.032 in. dia. lock-wire.

R (6) Connect electrical connectors to receptacles on inlet guide vane transducer and load compressor controller.

(7) Operate APU. Check inlet guide vane operation by observing APU response to normal and MAX MODE air load demands (Ref. 49-00-01).

INLET GUIDE VANE (IGV) ASSEMBLY - ADJUSTMENT AND TEST

1. General

The following procedures contain instructions for pneumatically holding the inlet guide vanes open for visual inspection, and for checking operation of the load compressor inlet guide vane (IGV) assembly. Included are checkout procedures for the IGV feedback transducer, which supplement the transducer adjustment procedures presented in section 49-51-07.

2. Equipment and Materials

C Pneumatic Pressure Source, clean shop air or nitrogen supply.

C Test Set GEN 3395.

C Volt-Ohm-Milliameter, Simpson Model 460, or equivalent. Test
C Harness GEN 3672

3. Referenced Procedures

49-51-07 Inlet Guide Vane Feedback Transducer - Removal and Installation

4. Operational Test

A. Procedure to Open Inlet Guide Vanes

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 214, open and tag APU power circuit breakers (B9 through B16).

(2) Attach MAINTENANCE IN PROGRESS sign to APU control panel, zone 215.

R NOTE: Step 4A(3) is necessary only for the purpose of visually checking the guide vanes for general condition or position. The step may also be omitted on inlet guide vane assemblies having an inspection hole and index of guide vane position when only vane position is desired.

(3) Loosen the clamps on the load compressor inlet duct boot and slide the boot aft to expose the inlet guide vanes.

C (4) Remove test port plug G1 at the bottom of the surge
C control valve and install test set GEN 3395.

(5) Connect test pressure hose to test fitting and slowly increase test pressure. The inlet guide vanes must start to open at approximately 3 psig and be full open at approximately 12 psig.

NOTE: There will be a normal bleeding of air from the load compressor controller vent port.

Inlet guide vane actuation may be viewed through the inlet guide vane assembly air inlet port or verified by observing the guide vane position index marks on inlet guide vane assemblies equipped with a vane position indicator.

(6) Reduce test pressure to 0 psig. Inlet guides must close.

R (7) If no further testing is required, perform Steps 4E(1)
R through 4E(6).

B. Inlet Guide Vane Assembly

R (1) Perform Steps 4A(1) through 4A(5).

(2) Verify that air is bleeding from the load compressor controller vent port; if not, the controller is faulty and must be replaced.

(3) Verify that guide vanes go full open; if not, hold finger over the load compressor controller vent port. If the vanes still do not go open, proceed as follows:

(a) Decrease test pressure to 0 psig and disconnect the hose from the test fitting.

(b) Disconnect the pneumatic line (J-Tube) at the load compressor actuator and connect the test hose to the actuator air inlet fitting.

(c) Increase test pressure to 30 psig (maximum). If the inlet guide vanes now go full open, suspect a faulty load compressor controller. If the vanes do not open, suspect a faulty inlet guide vane actuator or IGV actuating mechanism.

(d) Disconnect the test pressure hose and reconnect the pneumatic line to the actuator air inlet fitting.

(c) Attach test hose to GS13841-1 test fitting and drive inlet guide vanes open. Check for leakage past O-ring seat at the J-tube connection to the load compressor controller. If there is leakage, replace O-ring seal.

(4) If no further testing is required, perform Steps 4E(1) through 4E(6).

C. Load Compressor Controller (Torque Motor Continuity Check)

(1) Disconnect JS15 harness connector.

(2) Jumper pins 1 and 2 of controller electrical receptacle.

(3) Measure torque motor lead wires to body resistance by adding jumper between pins 1 and 2 and measuring from either pin 1 or pin 2 to controller body. Resistance must not be less than 200 megohms.

(4) Remove jumper and measure torque motor coil resistance between pins 1 and 2. Resistance must be 33 to 39 ohms (at 70 degrees F).

(5) Replace controller if it does not conform to the above requirements.

(6) Reconnect JS15 harness connector.

D. IGV Feedback Transducer Adjustment

(1) Disconnect electrical connector at the IGV feedback transducer.

(2) Install test harness GEN 3672.

(3) Remove APU firewall connector P1 (starter connector).

(4) Position APU master switch to ON and depress start switch.

(a) Note that doors open and don't load light illuminates.

(5) Open IGV's by performing Steps A(1) through (3) this section. Ensure IGV's are full open.

(6) Check for 15 VDC between Burnde Block 3 of GEN 3672 and ground.

C (7) Check for 8.00 to 8.10 VDC between Burnde Block 1 of
C GEN 3672 and ground with IGV's full open.

C (a) If not, adjust feedback transducer by loosening 4
C mounting screws and rotating transducer until 8 to
C 8.1 VDC is obtained.

C (b) Tighten and safety mounting screws. Insure that
C voltage does not change.

C (8) Depress APU stop switch. After doors close, place
C APU master switch to OFF.

CR (9) Perform test completion Step 4E this section.

C (10) Remove test harness GEN 3672 and connect feedback
C transducer electrical connector.

C (11) Connect APU firewall connector P1.

C (12) Check APU operation in minimum, normal and maximum
C modes of operation.

R E. Test Completion

(1) Disconnect test pressure hose.

(2) Remove test fitting GS13841-1 and reinstall G1 test port plug using new performed packing.

(3) Reconnect signal harness plug JS13 and add lock-wire.

(4) If removed, reinstall load compressor inlet duct boot. Tighten boot clamps to a torque of 20 lb in.

(5) Remove MAINTENANCE IN PROGRESS sign from APU control panel.

(6) Remove tags and close circuit breakers opened in Step 3A(1).

(7) Operate APU and check response of inlet guide vane assembly to NORM and MAX MODE commands.

CR INLET GUIDE VANE ASSEMBLY - INSPECTION/CHECK

CR 1. Inlet Guide Vane Tester

CR A. The purpose of the tool GEN 3395 is to open the APU inlet guide vanes for inspecting the load compressor, and also checking the operation of the inlet guide vane assembly. The tool consists of an air pressure regulator, 0 to 15 psig gage, flexible hose and a special test fitting. This tool will be issued to all L-1011 layover stations.

CR 2. Procedure for Use of Inlet Guide Vane Tester - GEN 3395

CR A. To open the IGV and inspect the load compressor:

CR (1) Loosen the clamps on the load compressor inlet duct rubber boot, slide the boot aft until the vanes can be observed.

CR (2) Remove the G 1 test port plug on the surge bleed valve, - refer IPC 49-51-08, Figure 1, Item 25, and screw the special test fitting into G 1 port, hand tight.

CR (3) Adjust the pressure regulator to apply a maximum of 12 psig.

CR (4) The inlet guide vanes should open to their maximum position and the load compressor can be viewed through the open vanes.

CR NOTE: While the check is in progress, air will be escaping from the load compressor controller vent port.

CR (5) After inspection, reduce air pressure to 0 and remove the test fitting from the G1 port. Reinstall G 1 port plug.

CR (6) Slide rubber boot forward and secure with clamps. Torque clamps to 20" lb-in.

CR B. To check operation of the inlet guide vanes:

CR (1) Loosen the clamps on the load compressor inlet duct rubber boot, slide the boot aft until the vanes can be observed.

CR (2) Remove the G 1 test port plug on the surge bleed valve,
CR - refer IPC 49-51-08, Figure 1, Item 25, and screw the
CR special test fitting into G 1 port, hand tight.

CR (3) Adjust the pressure regulator to increase pressure.
CR Note that the vanes open smoothly as pressure increases
CR and are full open by 12 psig maximum.

CR NOTE: While the check is in progress, air will be
CR excaping from the load compressor controller
CR vent port. If air is not escaping, suspect vent
CR port being plugged and the controller should be
CR changed.

CR (4) If the inlet guide vanes open part way in Step B(3).

CR (a) Plug the load compressor controller vent port by
CR placing a finger over the hole.

CR 1) If the vanes now open, the inlet orifice to
CR the controller should be changed.

CR 2) If the vanes do not move, proceed to Step
CR B(5).

CR (5) If the vanes do not operate in Step B(3):

CR (a) Remove the pneumatic line attached to the IGV
CR actuator, refer IPC 49-51-05, Figure 1, Item 50.

CR (b) Remove special test fitting from G 1 port of the
CR surge valve and remove special test fitting from
CR the flex hose.

CR (c) Attach flex hose to the IGV actuator fitting and
CR apply 12 psig into actuator.

CR 1) If IGV now opens, suspect faulty load
CR compressor controller.

CR 2) If IGV still will not open, then the IGV
CR assembly is at fault.

CR (d) Reinstall pneumatic line on IGV actuator and
CR reinstall special test fitting on flex hose.

CR (6) Reinstall G 1 port plug on surge valve.

CR NOTE: Replace the O ring.

CR (7) Slide the rubber boot forward and secure with clamps.
CR Torque clamps to 20 lb-inches.

INLET GUIDE VANE FEEDBACK TRANSDUCER - REMOVAL AND INSTALLATION

C 1. Equipment and MaterialsLock-wire, Federal specifications
C QQ-W-390, .020-inch diameter or equivalent.
Volt-Ohm-Milliameter, Simpson Model 260-6M, or equivalent

CR 2. Referenced Procedures

CR 49-51-05 Inlet guide vane assembly - Adjustment and Test

CR 3. Removal/Installation

C (1) Open access doors 319CL, 319DR, 319BR.

C (2) Remove electrical connector from feedback transducer.

C (3) Remove nut securing electrical connector to cover.

C (4) Remove locknuts and washers retaining cover.

C (5) Remove cover and, if applicable, rubber gasket. Note
C approximate orientation of resistor wiper terminal for
C ease of re-assembly.

C (6) Unsafety and remove four screws and retaining clamps
C and remove transducer.

B. Installation

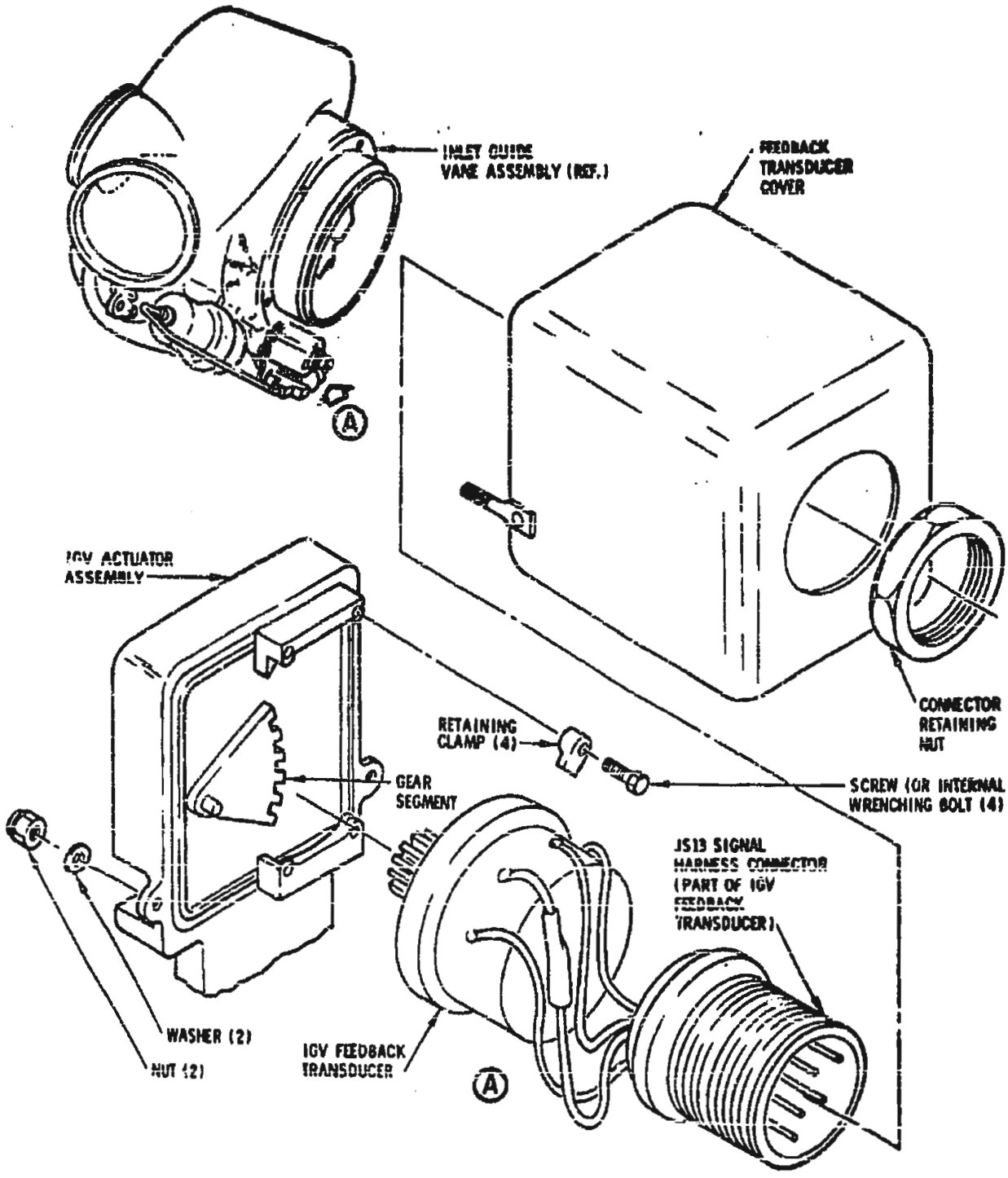
C (1) Install transducer and loosely retain with four screws
C and retaining clamps.

C NOTE: Orient resistor wiper terminal in approximately
C same position as removed part.

C (2) Adjust transducer per maintenance manual 49-51-05; then
C torque the four screws to 2 to 3 pound inches and
C safety.

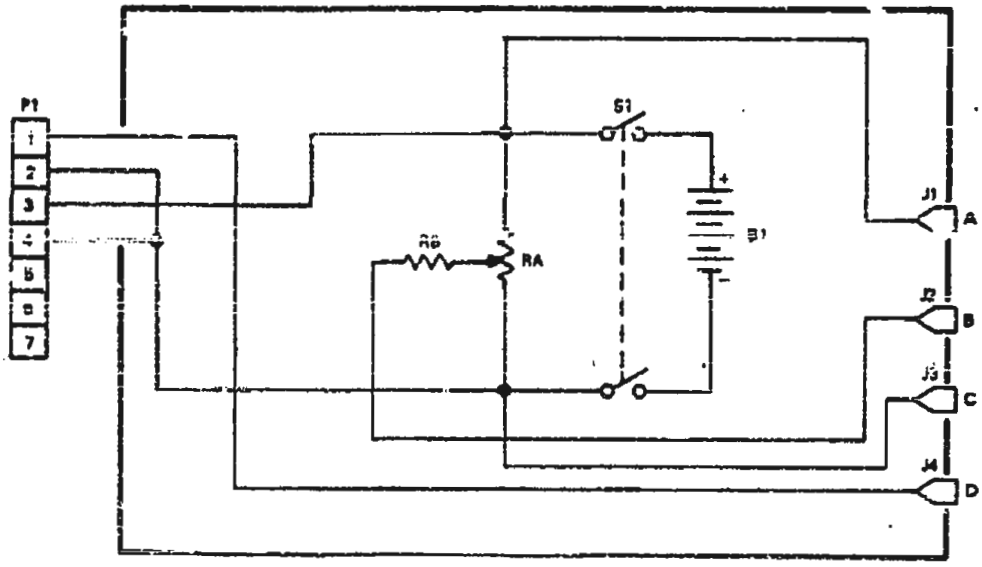
C (3) Re-install rubber gasket, if applicable, and cover
C while guiding electrical connector through hole in
C cover.

C (4) Secure cover with self-locking nuts and washers.
C Position centerline of connector master key in line
C with ambient vent port of actuator and secure with
C connector nut.



M1-0100-07-469

IGV Feedback Transducer - Removal and Installation
Figure 401



DESIGNATOR	NOMENCLATURE	SUGGESTED PART/MFR
B1	BATTERY	BURGESS U10 (15V) OR EQUIVALENT
J1, J2, J3, J4	TERMINAL	MS39024/10-1, -2, -3, -4 OR EQUIVALENT
P1	CONNECTOR	MS24266R14T7SN OR EQUIVALENT
R_A	VARIABLE RESISTOR	10K (±5%) 0.3% LINEARITY, MULTITURN EXAMPLE: SPECTROL RT 12C2L103 OR BETTER
R_B	FIXED RESISTOR	499 OHMS (±1.0%), 1/10 WATT – RNR55C499F OR BETTER
S1	OFF-ON SWITCH	DPST, JAN-S-23-ST52K OR EQUIVALENT
	BATTERY HOLDER	KEYSTONE NO. 166 OR EQUIVALENT
	CHASSIS	BUD NO. CU-3005A OR AS CONVENIENT
	TERMINAL STRIP	OPTIONAL – CINCH NO. 55A OR EQUIVALENT
	MISCELLANEOUS	GROMMET, WIRE, CLAMP, SCREWS, NUTS, WASHERS, SOLDER

NOTE

1. TEST SET HARNESS MUST BE INTERNALLY RESTRAINED AND PROTECTED BY GROMMET AND TEFLON SLEEVING OR SPIRAL WRAP. SUGGESTED HARNESS LENGTH TO BE 4 FEET
2. REFER TO 49-51-07 STEP C FOR CALIBRATION REQUIREMENTS
3. BATTERY (B1) MUST BE READILY REMOVABLE FOR CONDITION CHECK AND RECHARGING (OR REPLACEMENT) PRIOR TO USE OF TEST SET

EM1–0100–49–488

IGV Feedback Transducer Test Set
Figure 402

CR CR (5) Check operation of APU in minimum, normal, and maximum modes.

C. IGV Feedback Transducer Null Position Adjustment

NOTE: Before using IGV Feedback Transducer Test Set, check test set battery. Recharge or replace battery as required.

(1) Connect IGV Feedback Transducer Test Set (Ref. Fig. 402) to transducer electrical connector (Ref. Fig. 401).

(2) Pressurize inlet guide vanes firmly against full open stops (Ref. 49-51-05, Step 4A).

(3) Adjust IGV feedback transducer null point as follows:

(a) With Simpson Model 260-6M VOM, or equivalent, connected to terminals B (pos) and D (neg) and set to +10 volt DC range, turn on test set and note polarity and magnitude of null error voltage (switch to -10V range if necessary). Positive error voltage indicates wiper output voltage is greater than test set reference voltage and clockwise rotation of potentiometer body is required. Magnitude of about 7 volts indicates approximately 180° of rotation is necessary. If required, rotate potentiometer body to reduce null error toward zero volts.

(b) When error voltage is less than 2.5V (or +1V, if available), switch meter range and, if required, continue slowly rotating potentiometer body until error voltage is less than 0.25 volt.

(c) When error voltage is less than 0.25 volt, change meter setup to read 50 microamp/250 millivolt range (insert leads for proper polarity). If required, carefully adjust potentiometer body for a zero reading plus or minus 25 millivolts.

(d) Tighten transducer potentiometer attach screws to a torque of 2 to 3 lb inch, taking care to maintain null point obtained in preceding step.

(e) Return to +10 volt DC range and switch meter to terminals D (pos) and C (neg) of test set. Remove actuator port pressure and note voltage reading. Reading should be less than +3 volts without going through zero volts and back to +15 volts.

(4) Turn off test set and disconnect test set harness from transducer.

5. IGV Feedback Transducer Test Set Calibration

(1) Calibrate IGV Feedback Transducer Test Set (Ref. Fig. 402) at 6 month intervals as follows:

(a) Remove chassis cover and set S1 in OFF/CAL position.

(b) Using a suitable regulated DC power supply and 5 place or better digital voltmeter (DVM) connect +15.000 (±0.005)V dc to terminals A (+) and C.

(c) Connect DVM across terminals B and C. If necessary unlock or unseal test set resistor (RA) and adjust for DVM reading of ±8.05 ±0.01V dc.

(d) Lock or seal RA adjustment and recheck DVM reading.

(e) Turn off and disconnect test equipment. Check and recharge or replace battery.

(f) Reinstall test set cover.

(2) Affix calibration date placard to test set cover.

CURRENT TRANSFORMER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Antiseize Thread Compound, ESSO No. 2, or equivalent

2. Referenced Procedures

	24-41-00	External Power/Ground Service System - Maintenance Practices
R	49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker APU BAT BUS - CONT PWR.

(2) In aft fuselage, zone 316, open APU compartment access doors 319AL and 319CL.

(3) Disconnect electrical connector from current transformer (Ref. Fig. 401).

(4) Disconnect electrical leads from terminals on generator and tag leads.

(5) Remove screws attaching current transformer to compressor housing bracket and remove transformer.

B. Installation

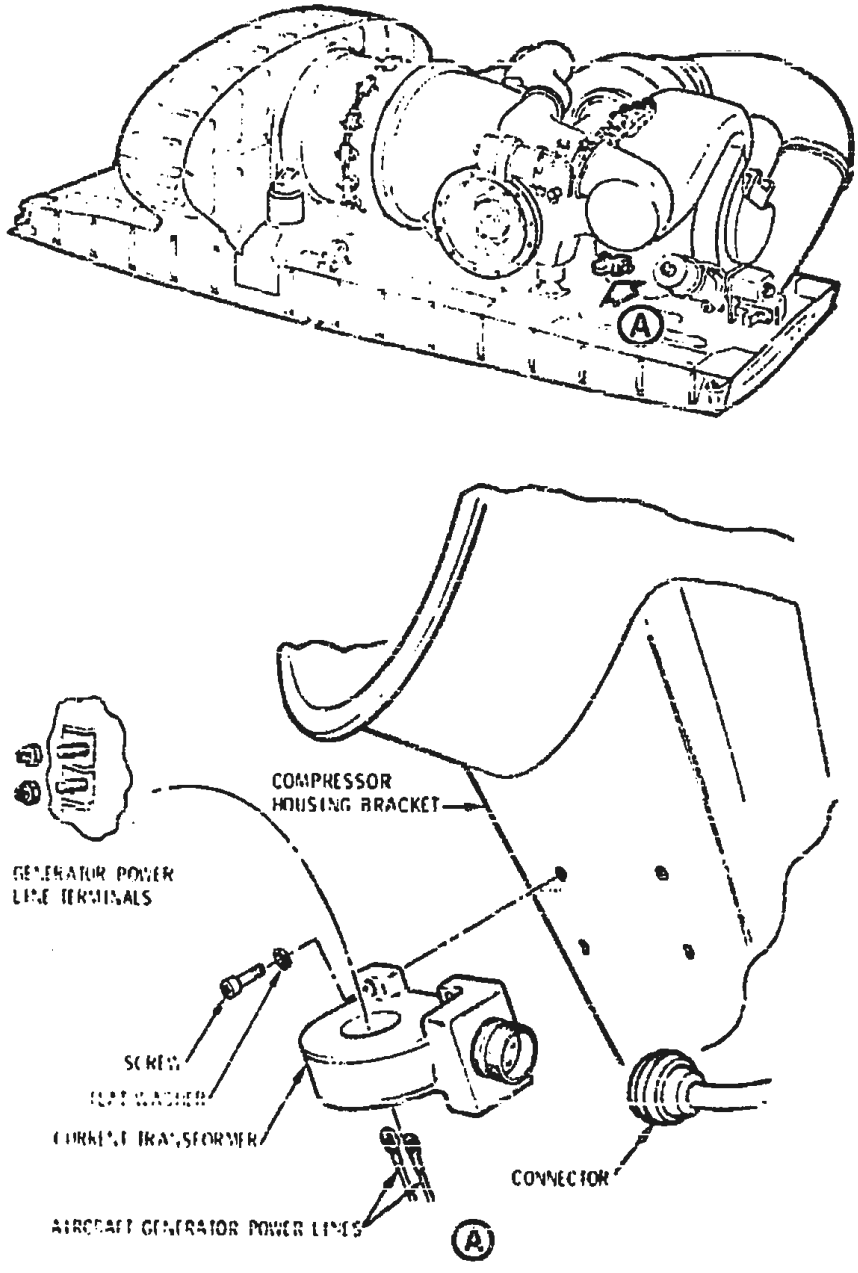
(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Install current transformer to compressor housing bracket. Lubricate screw threads with antiseize compound.

(3) Torque screws 20 to 25 lb in.

(4) Route generator leads through current transformer and attach to generator terminals.

(5) Connect electrical connector to current transformer.



R R Current Transformer - Removal and Installation
Figure 401

R R EFFECTIVITY: ALL

0508

(6) Close APU compartment access doors.

(7) Remove tag and close circuit breaker opened in Step 3A(1).

(8) Turn on electrical power (Ref. 24-41-00).

R (9) Operate APU to check current transformer operation
R (Ref. 49-00-01).

(10) Turn off electrical power (Ref. 24-41-00).

SURGE VALVE ASSEMBLY - REMOVAL AND INSTALLATION

1. Equipment and Materials

Preformed packings (Ref. Fig. 401)

Protective caps

Lock-wire, Fed Spec. QQ-W-390, 0.020 and 0.032-inch diameter or equivalent

Strap Wrench, Snap-On Tools Corp. A-91A, or equivalent

Lubricant, Dow Corning 44, or equivalent (Petrolatum VV-P-236 or APU Engine Oil are approved equivalents)

Spring scale (0 to 100 lb) or equivalent

Disimilar Metal Lubricant, Strontium Chromate A-136-2CP, or equivalent

2. Referenced Procedures

24-24-01 APU Generator Assembly - Removal and Installation

49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

CR CR CR NOTE: Due to difficulty of access, removal/installation of surge valve should be accomplished with APU removed from aircraft.

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker BAT PWR (CB10). Attach maintenance-in-progress tag to APU CONTROL panel.

(2) (Not applicable if APU is lowered out of the airplane.) Remove APU generator (Ref. 24-24-01).

(3) Cut lock-wire and loosen the three P3 air tube B-nuts at the surge valve fittings (Ref. Fig. 401).

(4) Disengage surge duct gland nut, using A-91A or equivalent strap wrench.

(5) Remove the V-band coupling at the load compressor housing and separate the surge valve assembly from the surge duct and load compressor. Discard the preformed packings at surge valve to surge duct and load compressor flanges.

(6) Remove the union at the P3 servo air port. Install protective cap.

(7) Remove two elbow fittings and jam nuts at the P3 air inlet and outlet ports. Install protective caps.

B. Installation

(1) Coat new preformed packings to be installed on fittings with a film of Dow Corning 44 lubricant, Petrolatum VV-P-236, or APU engine oil. Install one preformed packing on the pneumatic tube union, and one on each elbow fitting (Ref. Fig. 401).

(2) Coat threads of union and elbow fittings with a film of wet strontium chromate A-136-2CP.

(3) Install union.

(4) Install elbow fittings. (Do not tighten elbow fitting jamnuts until surge valve is installed and optimum alignment of fittings with pneumatic tubes is determined.)

(5) Lubricate two preformed packings, as in Step B(1). Place one packing at the surge valve load compressor flange and the other at the surge duct flange.

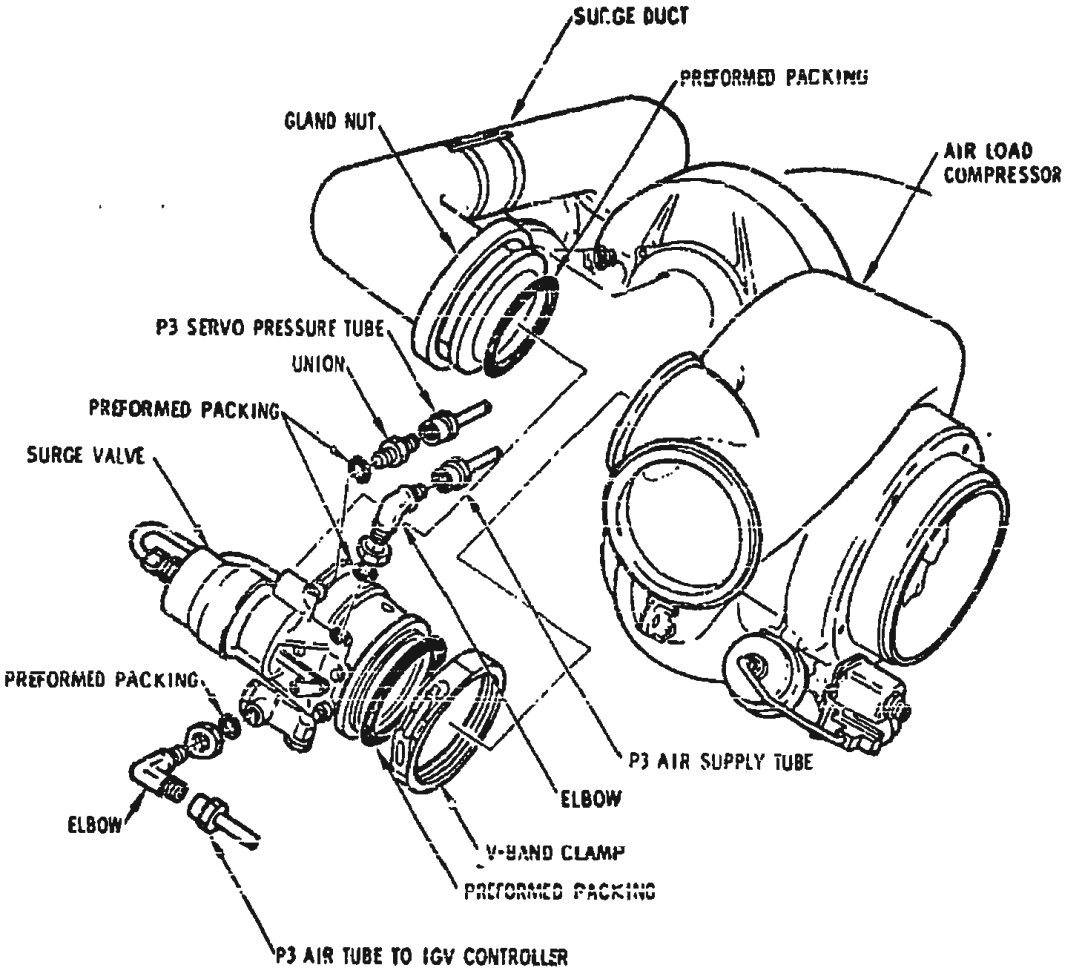
(6) Apply a film of wet strontium chromate to the inside diameter of the V-band coupling.

CAUTION: WHEN INSTALLING SURGE VALVE, ENSURE "J" TUBE IS CORRECTLY POSITIONED OVER PROTRUSION IN THE CENTER OF THE CAP (REF. FIG. 402).

(7) Place surge valve in position and engage P3 air tube B-nuts to fittings (do not torque fittings at this time).

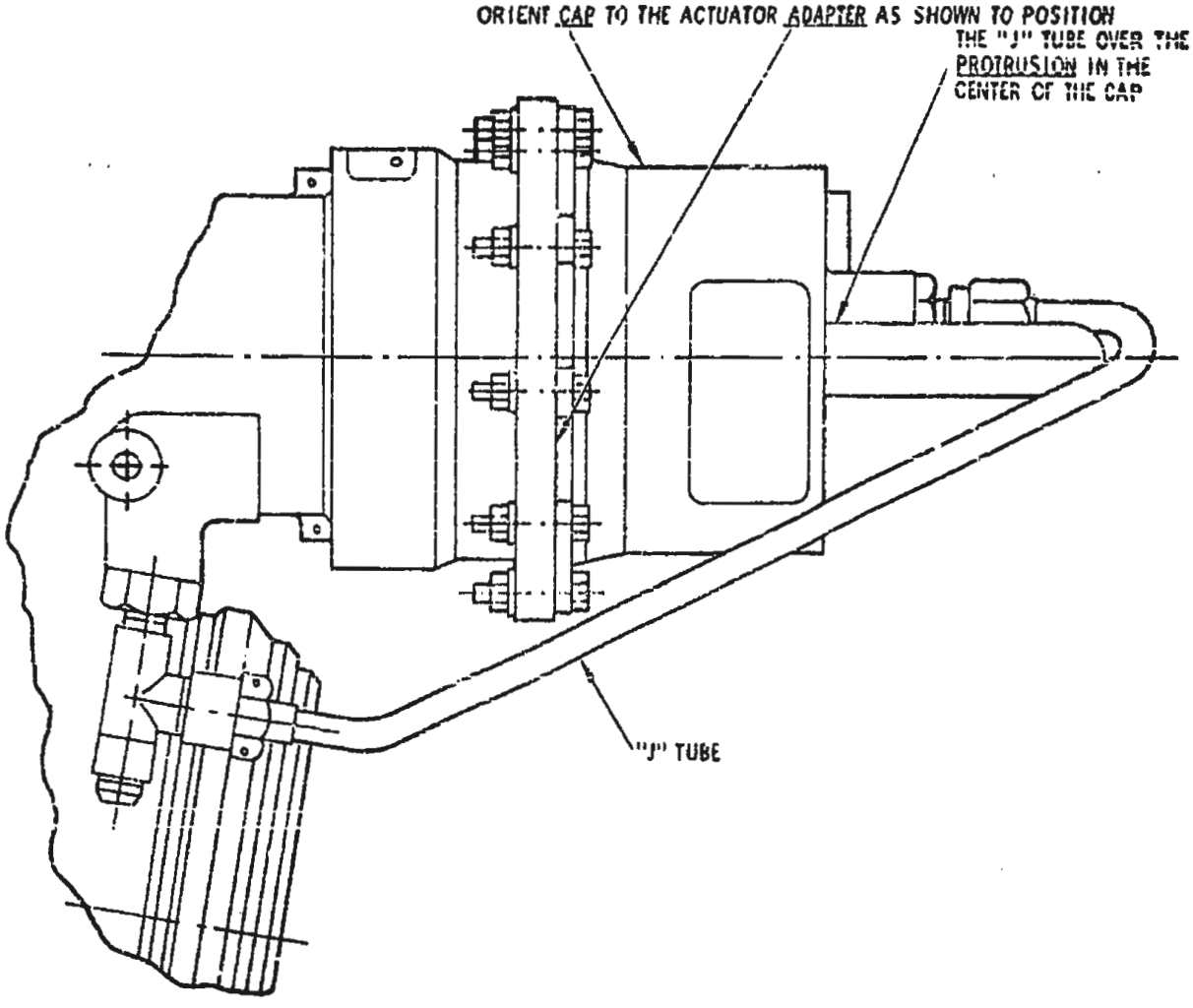
(8) Connect surge duct to the surge valve by threading on the surge duct gland nut. Tighten gland nut only handtight.

(9) Install V-band clamp. Tighten clamp only enough to assure torqueing of P3 air tube B-nuts without stressing P3 tubes.



M1-0101-49-133

R Surge Valve - Removal and Installation
R Figure 401



M1-0000-49-1058

R
R

Surge Valve Alignment
Figure 402

(10) Tighten elbow fitting jamnuts (2 places).

(11) Tighten P3 tube B-nuts (3 places) to a torque of 270 to 300 lb in. Install 0.020-inch diameter lock-wire between B-nut and union, and between B-nuts at elbow fittings and elbow fitting jamnuts.

(12) Tighten V-band coupling to a torque of 100 to 120 lb in.

(13) Tighten surge duct gland nut to a torque of 25 to 40 lb in. using strap wrench A-91A, or equivalent, and a pull-type spring scale. Safety gland nut in two places using 0.032-inch diameter lock-wire.

(14) (If applicable) Reinstall APU generator (Ref. 24-24-01).

(15) Remove tag and close circuit breaker opened in Step 3A(1). Remove maintenance-in-progress tag

(16) Operate APU (Ref. 49-00-01). With ECS packs on, momentarily switch to NORM and MAX MODE positions. Check for proper load compressor response to pneumatic load changes.

NOTE: With no ECS packs on, the surge valve piston link is full aft (extended). As ECS packs are turned on, the link moves forward and will be full forward with three ECS packs on.

SURGE VALVE CONTROLLER AND SHOCK SWITCH - REMOVAL AND INSTALLATION

1. General

The surge control system pneumatically operated shock switch is installed between the surge valve controller and load hardware gearbox case and retained in position by the controller attach bolts. Since replacement of the shock switch requires removal and reinstallation of the surge valve controller, replacement of both units is combined in a single procedure.

CR CR NOTE: Refer to 49-00-01 Adjustment/Test for Rate Sensor Operational Check.

2. Equipment and Materials

Lock-wire, Fed Spec. QQ-W-390, 0.032-inch diameter, or equivalent

Dissimilar Metal Lubricant, Strontium Chromate Epoxy Primer, A-136-2CP, or equivalent

Preformed Packing Lubricant, Dow Corning 44, or equivalent (Petrolatum VV-P-236 or APU Engine Oil are approved equivalents)

Preformed Packing (Ref. Fig. 401)

Protective Caps (As Required)

Thread lubricant, Petrolatum graphite, MIL-T-5544, or equivalent

3. Referenced Procedures

49-00-01 Auxiliary Power Unit (APU) - Removal and Installation

49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

4. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker BAT BUS (B10). Attach maintenance-in-progress tag to APU CONTROL panel.

(2) Gain access to surge valve controller and shock switch (Ref. Fig. 401) by lowering the APU out of the APU compartment (Ref. 49-00-01).

(3) Remove surge valve control pressure tube installed between shock switch and T-fitting.

(4) Remove surge valve control pressure tube installed between elbow fitting at top of surge valve controller and T-fitting.

(5) Remove P3 air inlet tube between surge valve controller and T-fitting.

(6) Disconnect load compressor inlet air pressure tube from elbow fitting at top of surge valve controller.

(7) Remove three surge valve controller attach screws and washers.

NOTE: Controller attach screws are of three different lengths. To facilitate proper reinstallation, tag bolts when removed.

(8) Remove surge valve controller and shock switch.

(9) Discard preformed packing installed at Po pressure sensing tube installed in the load hardware gearbox case and at air inlet ports of surge valve controller and shock switch.

(10) Remove NAS 552-6 elbow fittings at top of surge valve controller. Discard preformed packing at both ends of elbow fittings. Install protective caps.

(11) Remove union at P3 air inlet port. Discard preformed packing and install protective cap.

(12) If shock switch is being replaced, remove union at P servo port. Discard preformed packing and install protective cap.

B. Installation

(1) If new shock switch (Ref. Fig. 401) is being installed, coat contact surface between union and surge control pressure port boss with a film of strontium chromate, A-136-2CP. Lubricate preformed packing with specified lubricant and install on union. Install union and tighten until it is firmly seated. Lock-wire union using 0.032-inch diameter wire.

(2) Install elbow fittings at top of surge valve controller as follows:

(a) Lubricate preformed packing and install on elbow fitting attach bolts.

(b) Install bolts through elbow fittings.

(c) Install lubricated preformed packing on protruding portion of attach bolts.

(d) Coat contacting surfaces of elbow and surge valve controller with strontium chromate.

(e) Lubricate threaded area of elbow bolts and install elbows. Do not torque elbow attach bolts until surge valve controller and shock switch is mounted and alignment of elbows with tubing assemblies is determined.

(3) Coat contact surfaces of union to be installed in P3 air inlet port with strontium chromate. Install lubricated preformed packing on union and screw union into P3 air port. Tighten union until it is tightly seated. Lock-wire union using 0.032-inch diameter wire.

(4) Lubricate preformed packing and install at air inlet ports of surge valve controller and shock switch.

(5) Lubricate preformed packing and install on Po pressure sensing tube.

(6) Coat washers with film of strontium chromate and install washers on controller attach screws. Apply a film of petrolatum graphite to the screw threads.

(7) Place shock switch in its installed position taking care that Po pressure sensing tube is properly engaged to Po port in shock switch. Take care not to dislodge the preformed packing at the air inlet ports.

(8) Place the surge valve controller in its installed position against the shock switch (take care not to dislodge the preformed packing at the valve inlet air ports). Insert the controller attach screws through the controller and shock switch and screw them into the threaded bosses in the load hardware gearbox case. Refer to Fig. 401 for location of screws which are of different lengths.

(9) Tighten screws to a torque of 20 to 30 lb in. higher than the screw running torque of 2 to 18 lb-inches. Lockwire screws using 0.032-inch diameter wire.

(10) Install tubes removed in Steps 4A (3 through 5) and attach tube disconnected in Step 4A(6). Tighten tube nuts to a torque of 180 to 200 lb in. and lockwire tube nuts using 0.032-inch diameter wire.

(11) Tighten elbow fitting bolts at top of surge valve controller to a torque of 120 to 130 lb in. and lockwire bolts using 0.032-inch diameter wire.

(12) Reinstall APU (Ref. 49-00-01).

(13) Remove tag and close circuit breaker opened in Step 4A(1) and remove maintenance-in-progress tag at APU CONTROL panel.

(14) Operate APU in normal mode with one ECS pack on (Ref. 49-00-01). Observe position of surge valve piston link. Turn on additional ECS packs. Piston link must move forward into the piston housing as the second and third ECS pack is turned on and must be full forward with all three packs on. There must be no signs of leakage at any of the surge system tubing connections or fittings.

CR 5. APU Air Press Adjustment

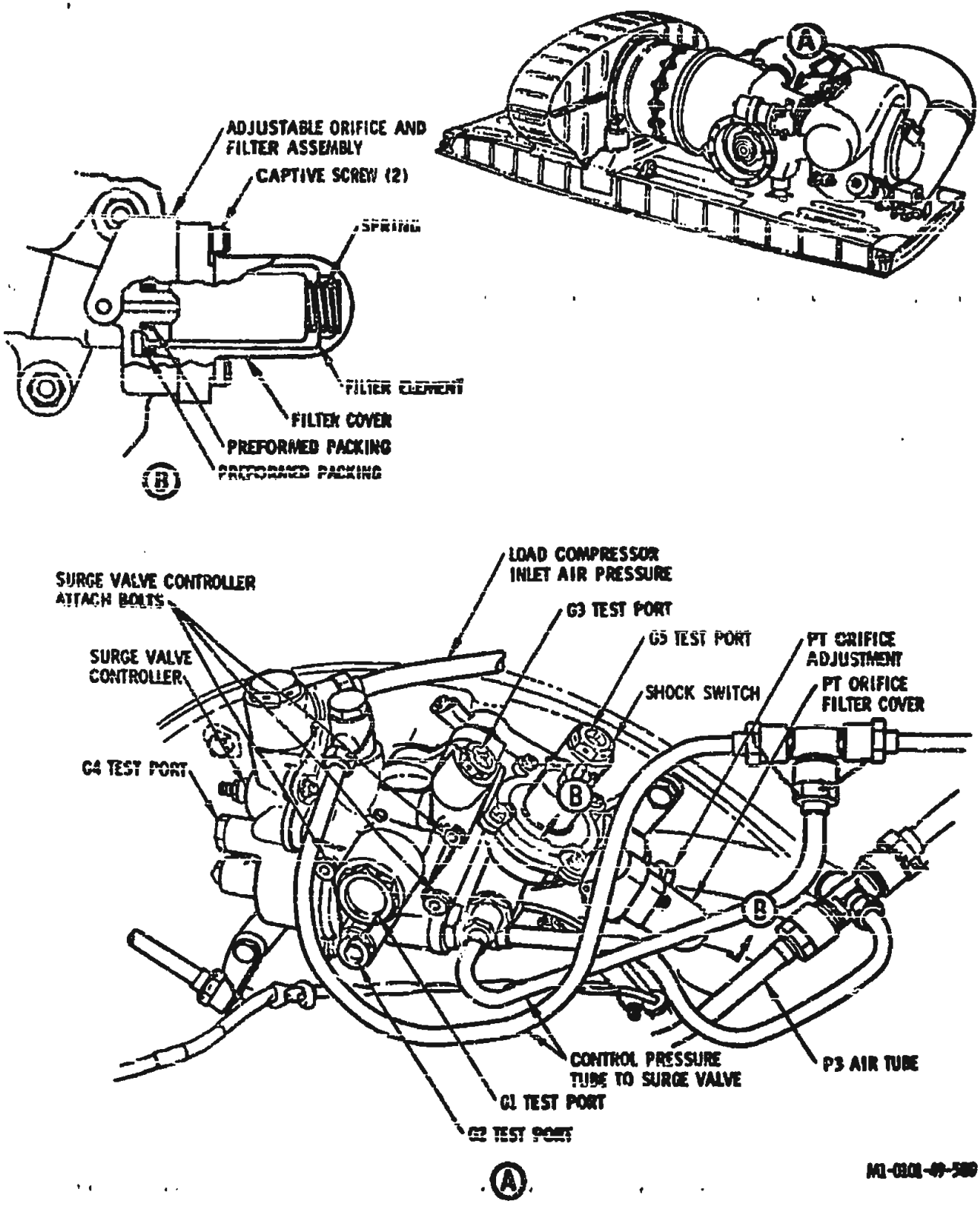
CR A. Normal air pressure from the APU is approximately 28 PSI in maximum mode with two ECS packs operating. Anytime the air pressure exceeds 30 PSI the load compressor may surge and cause N_2 overspeed shutdowns when an airload is reduced. Surging is detrimental to the load compressor and N_2 overspeed shutdowns from max mode damage the engine hot section.

CR CAUTION: THE FOLLOWING PROCEDURE MUST NEVER BE USED TO INCREASE DUCT PRESSURE. SEVERE COMPRESSOR DAMAGE COULD RESULT FROM IMPROPER ADJUSTMENT.

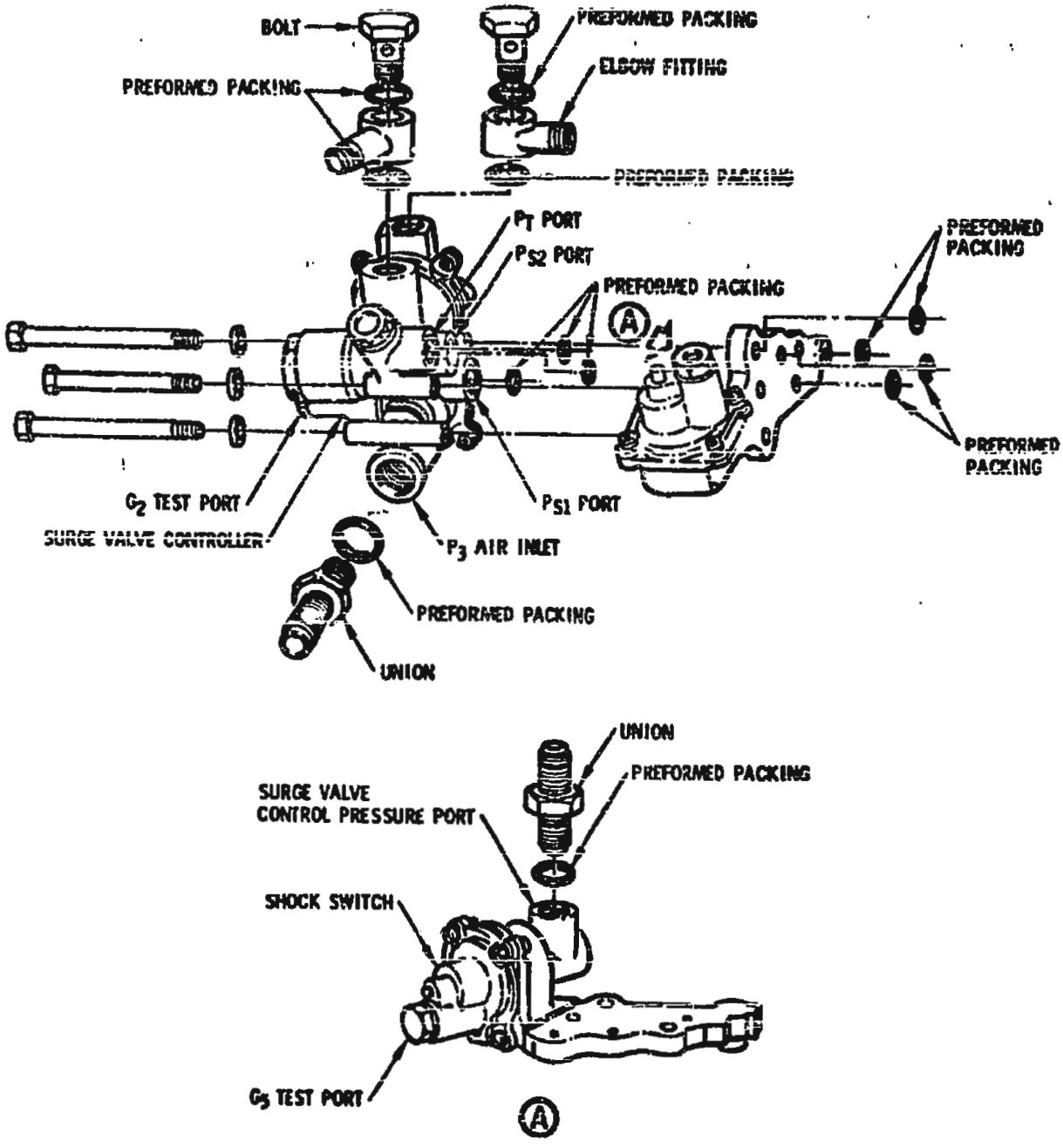
CR B. Procedure to reduce APU duct pressure.

CR (1) Open APU access door 319CL.

CR (2) If red RTV is covering variable orifice, remove the RTV to gain access to the adjustment Allen screw. See view A, variable orifice is located adjacent to the small filter bowl on the load gearbox above the APU generator.



R Surge Valve Controller and Shock Switch - Removal and Installation
R Figure 401 (Sheet 1)



M1-010-49-241

R Surge Valve Controller and Shock Switch - Removal and Installation
R Figure 401 (Sheet 2)

R EFFECTIVITY: ALL

R
R
001B

CR NOTE: The adjustment screw is in the center of the hex
CR cap and is prevented from rotating by friction.
CR Do not loosen the hex cap.

CR (3) Using a 3/32" Allen wrench turn the adjustment screw
CR clockwise (CW) to lower pressure. Approximately 3/4
CR turn will lower air pressure from 31 PSI to 28 PSI.

CR (4) Operate APU in max mode with 2 ECS packs on and check
CR that air pressure is approximately 28 PSI.

CR NOTE: If air pressure was reduced too much, it is
CR permissable to increase the pressure.

CR CAUTION: NEVER ADJUST THE VARIABLE ORIFICE TO INCREASE
CR AIR PRESSURE FOR A LOW AIR PRESSURE PROBLEM.

CR NOTE: RTV does not need to be reapplied to adjustment
CR screw.

SURGE DUCT - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch-diameter, or equivalent

Preformed packings (Ref. Fig. 401)

R Gasket (surge valve to exhaust transition housing flange, Ref.
R Fig. 401)

R Strap Wrench, Snap On Tools Corp. A-91A, or equivalent

R Spring Scale (0 to 100 lb), or equivalent

R Lubricant, Dow Corning 44, or equivalent (Petrolatum VV-P-236,
R or APU engine oil are approved equivalents)

R Sealant, General Electric RTV154, or equivalent

R Insulation blanket gasket (Hamilton Standard P/N 747630, Ref.
R Fig. 401)

R Disimilar Metal Lubricant, strontium chromate A-136-2cpf, or
R equivalent

2. Referenced Procedure

49-00-01 Auxiliary Power Unit (APU) Assembly - Removal and Installation

3. Removal/Installation

A. Removal

R (1) Remove APU (Ref. 49-00-01).

R (2) Remove nut, washer, and bushing at the quill shaft
R clamp bracket (Ref. Fig. 401).

R (3) Using A-91A (or equivalent) strap wrench, disengage
R surge duct gland nut at the surge valve. Discard
R preformed packing.

R (4) At the exhaust transition housing, cut the thermal
R blanket lock-wire. Detach the flat band clamp and
R remove the thermal blanket halves from the surge duct.

(5) Reach into the transition duct and remove the eight surge duct attach screws and plate.

(6) Remove surge duct.

(7) Remove gasket attached to the surge duct port on the transition housing.

B. Installation

(1) Using dabs of RTV 15Y sealant, spot glue new gasket over the surge duct port on the exhaust transition housing (Ref. Fig. 401).

(2) Position surge duct between surge valve and exhaust transition housing with the quill shaft clamp engaged to the bracket mounted on the load hardware gearbox.

(3) Lubricate new preformed packing with film of Dow Corning 44 Lubricant, Petrolatum VV-P-236, or APU engine oil, and install packing at interface to surge valve.

(4) Thread surge duct gland nut onto surge valve. Hand-tighten gland nut only as required to assure proper attachment to the surge valve.

(5) Coat the threads of the eight surge duct-to-transition housing attach bolts with a film of wet strontium chromate A-136-2CP. Position the attach bolt bearing plate inside the housing. Install the bolts from inside the housing, through the plate and housing, into the surge duct flange. Tighten the bolts as follows:

(a) Note running torque of each bolt as it is threaded into the lock nut on the surge duct flange. Replace bolt if running torque is less than 3 lb in. or greater than 30 lb in.

(b) Add running torque to installation torque of 35 to 40 lb in. Tighten diametrically opposite bolts until all eight are tightened to specified torque.

(6) Secure quillshaft clamp to support bracket using bushing, washer, and nut.

NOTE: Attachment of the quillshaft clamp to the duct support bracket must not apply any that would tend to distort the quillshaft and strap assembly alignment. Add or subtract washers at support bracket mount pads to eliminate pre-load.

(7) Tighten surge duct gland nut to a torque of 25 to 40 lb in. using strap wrench A-91A or equivalent and a pull-type spring scale. Safety gland nut in two places using 0.032-inch diameter lock-wire.

(8) Temporarily retain the two halves of the surge duct thermal blankets in position with elastic bands or tape. Cut one piece of one-half inch wide thermal gasket material, 12 inches long, and trim to match the longitudinal seam of the blanket. Cut a second piece 14-1/2 inches long and trim to fit around the surge duct at the location of the flat band clamp.

(9) Remove the thermal blanket halves. Spot glue the gaskets in the above positions on the duct using RTV 154 sealant.

(10) Place blanket halves in position on the duct and retain in position by looping 0.032-inch diameter wire around the lacing capstans on the surge duct and transition duct blankets in a figure-eight pattern.

(11) Install and tighten the flat band clamp to a torque of 20 to 25 lb in.

(12) Check wire lacing for looseness and re-lace if necessary.

(13) Reinstall APU (Ref. 49-00-01).

CR 4. Surge Duct Link Replacement

CR A. Removal

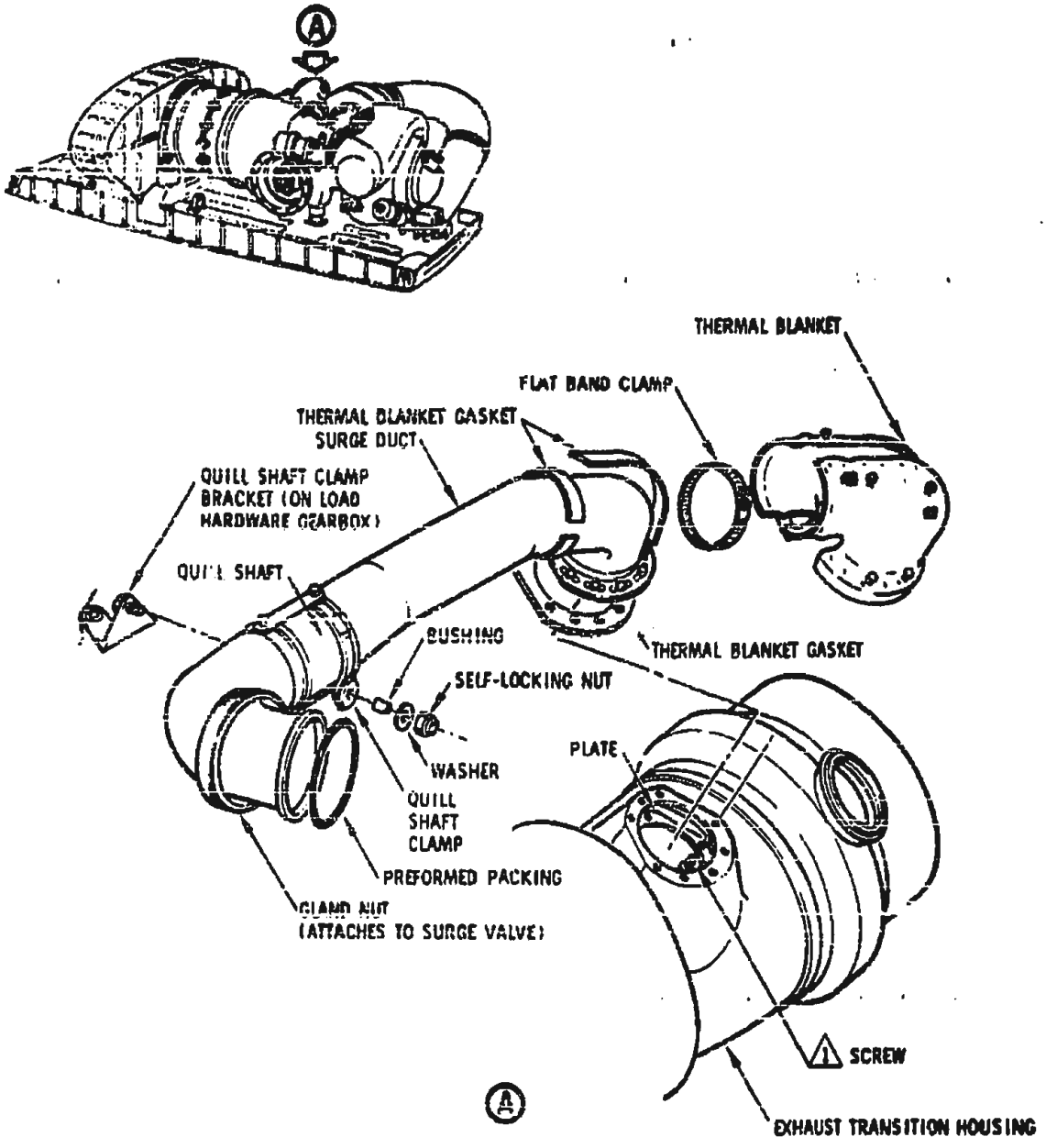
CR (1) Remove or lower APU from compartment (Ref. 49-00-01).

CR (2) Remove upper or lower link by removing bolts (2 places)
CR and washers.

CR B. Installation (Ref. IPC 49-51-07)

CR (1) If surge duct link is damaged or broken, obtain the
CR required parts and rivet together to the same length
CR (bolt hole to bolt hole) as strap removed.

CR NOTE: Top link is slightly longer than lower link [top
CR link 7.76 inch; lower link 7.575 inch
CR (approximate lengths)].



NOTE:
1 SCREWS AND PLATE ARE INSTALLED FROM INSIDE EXHAUST TRANSITION HOUSING.

MM 9577
MI-0101-49-144

R R Surge Duct - Removal and Installation
Figure 401

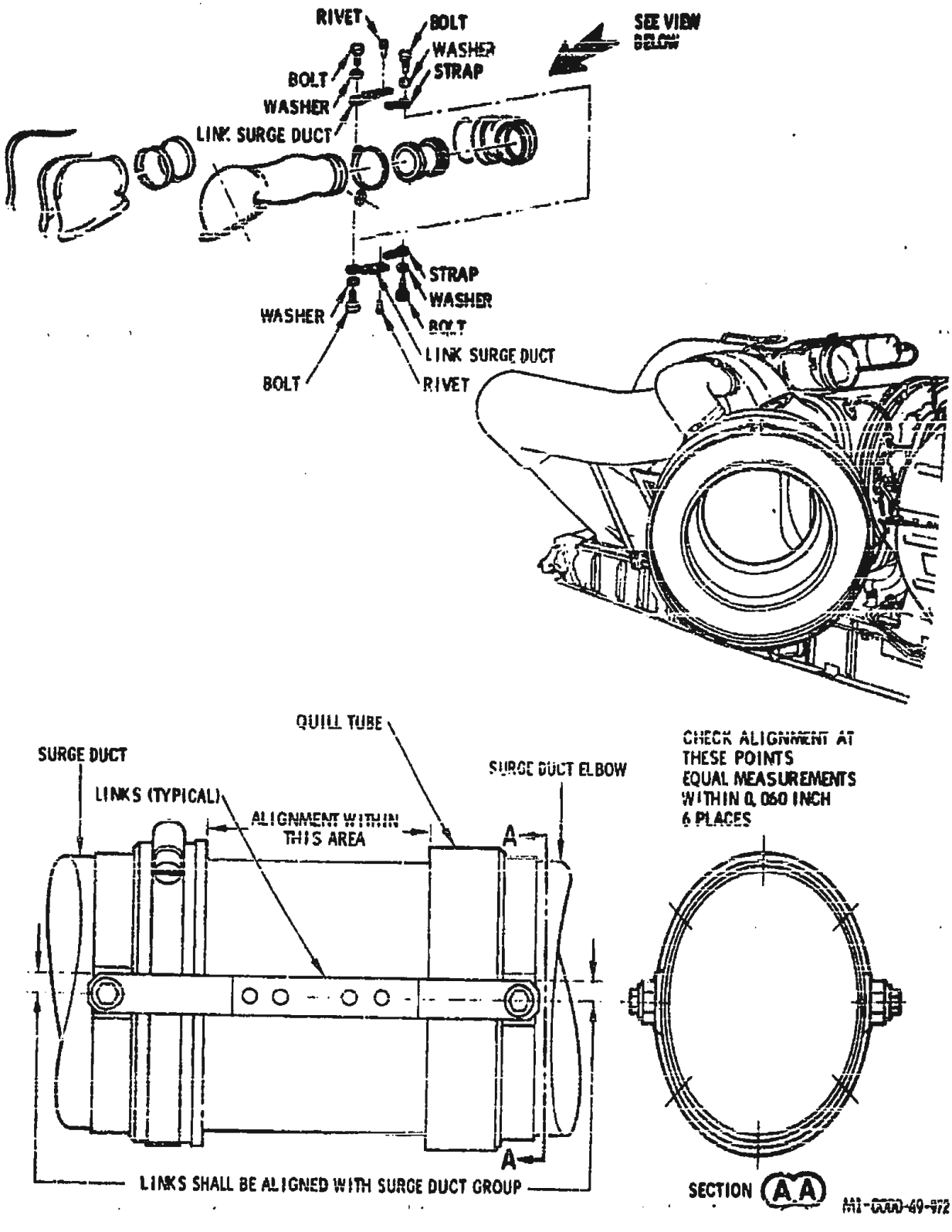
R EFFECTIVITY: ALL
R R
001B

CR (2) If length dimensions cannot be obtained from removed
CR link, alignment of surge duct, quill tube, and surge
CR duct elbow should be checked as follows:

CR (a) Measure dimensions between surge duct and surge
CR duct elbow at 6 locations equally spaced around
CR duct. Adjust surge duct elbow as necessary to
CR obtain dimensions within 0.060 inch.

CR (b) Position surge duct link onto surge duct and link
CR strap onto surge duct elbow. Tape links together,
CR remove and rivet together.

CR (c) Reinstall link assembly and attach with washers
CR and bolts. Torque bolts to 20 to 30 lb. inch and
CR lockwire.



CR
CR

Surge Duct Link - Removal and Installation
Figure 401A

R EFFECTIVITY: ALL
R
001B

FAN INLET AIR DUCT - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedure

49-00-01 Auxiliary Power Unit (APU Assembly - Removal and Installation

3. Removal/Installation

A. Removal

(1) Remove APU (Ref. 49-00-01).

(2) Loosen flat band clamps on APU fan inlet duct flexible coupling (Ref. Fig. 401).

(3) Remove mounting bolts and washers attaching duct to platform.

(4) Remove duct strut brace attachments.

(5) Remove fan inlet duct.

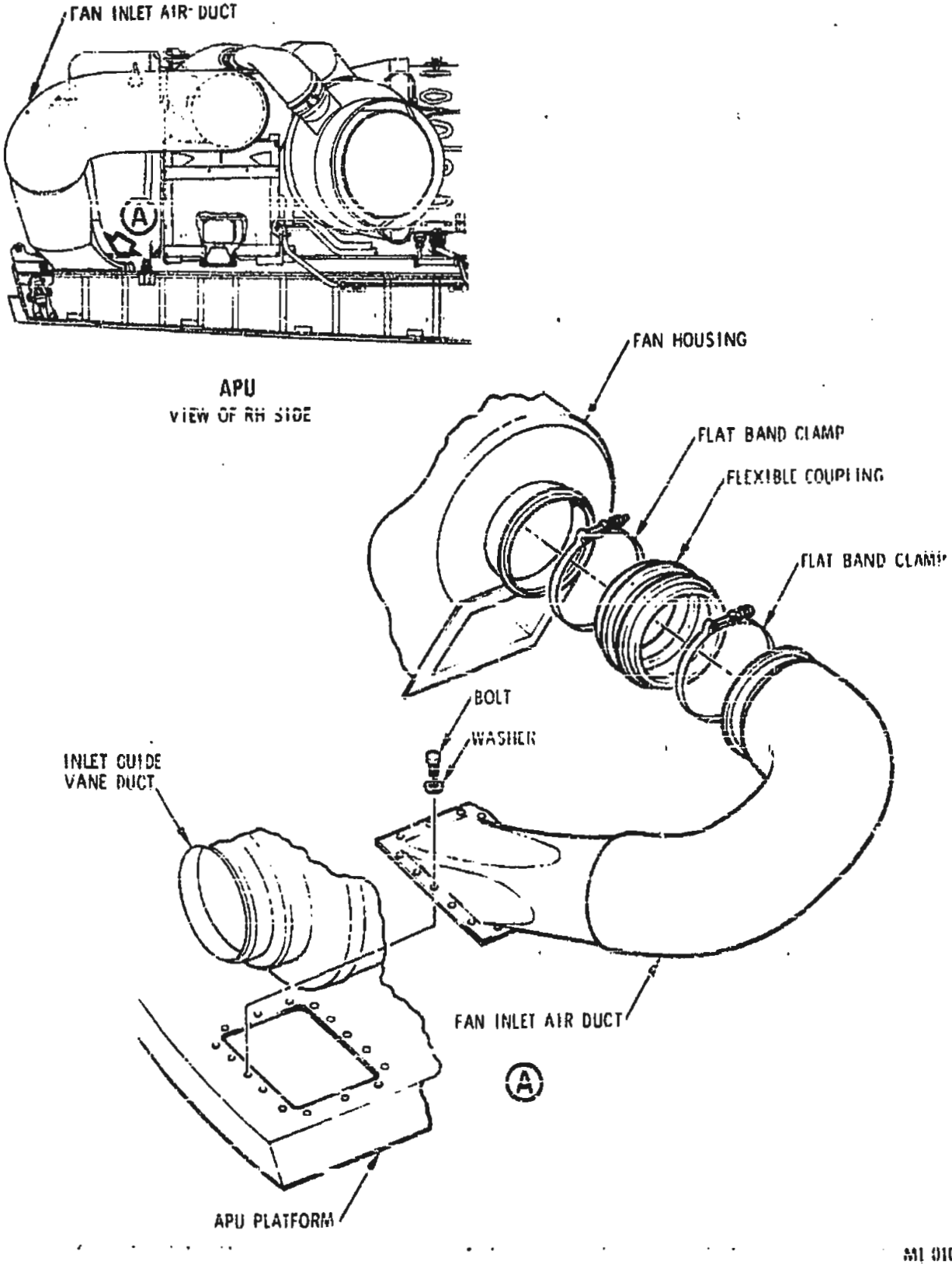
B. Installation

(1) Position inlet duct on platform and install flexible coupling and flat band clamps on duct and fan housing.

(2) Install mounting bolts and washers attaching duct to platform. Torque bolts 25 to 35 lb in. and lock-wire.

(3) Install duct strut brace attachment.

(4) Install APU (Ref. 49-00-01).



HH 9575
MI 0100-49-145

Fan Inlet Air Duct - Removal and Installation
Figure 401

LOAD COMPRESSOR DISCHARGE CHECK VALVE - REMOVAL AND INSTALLATION

1. Referenced Procedure

   20-36-01 Coupling - Single T-Bolt V-Band - Removal and Installation

2. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers B-9 through B14.

      (2) Remove access panel 317DL.

      (3) Disconnect forward and aft V-band couplings and remove APU load compressor discharge check valve (Ref. 20-36-01).

   B. Installation

      (1) Verify that circuit breakers opened in Step 2A(1) are open and tagged.

      (2) Position load compressor discharge check valve in its installed position with flow direction arrow facing forward and engage V-band couplings.

      (3) Tighten V-band couplings (Ref. 20-36-01).

R   (4) Reinstall access panel 317DL.

      (5) Remove tags and close circuit breakers opened in Step 2A(1).

R LOAD COMPRESSOR DISCHARGE CHECK VALVE - INSPECTION AND CHECK

R 1. Referenced Procedure

R 49-51-16 Load Compressor Discharge Check Valve - Removal and
R Installation

R 2. Inspection/Check

R A. Inspection

R (1) Remove Load Compressor Discharge Check Valve (Ref.
R 49-51-16, Removal and Installation).

R (2) Check general condition of flappers, hinges, and seats.
R Inspect for cracks, wear, and evidence of binding.

R (3) Reinstall check valve (Ref. 49-51-16, Removal and
R Installation).

IGV AIR FILTER ELEMENT - REMOVAL AND INSTALLATION

1. Equipment and Materials

Filter Element

Preformed Packing, Filter Element

Preformed Packing, Filter Bowl to Filter Head

Back-up Ring, Filter Bowl to Head Assembly

Cleaning Solvent, Acetone (Fed. Spec. O-A-51) or Trichloroethylene (Fed. Spec. O-T-634 Type II)

Lock-wire, Fed. Spec. QQ-W-390, 0.032-in diameter, or equivalent

Lubricant, Dow Corning 44A, or equivalent (procurable from Dow Corning Corp., Midland, Michigan 48641)

Lubricant, Petrolatum Graphite (MIL-T-5544)

2. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breakers B9 through B17.

(2) Open APU compartment access doors 319AL and 319CL.

(3) Remove filter bowl (Ref. Fig. 401).

(4) Remove filter element.

NOTE: Do not discard removed filter; filter element is reusable and should be sent to an appropriate shop facility for cleaning.

R (5) Remove and discard filter head preformed packing.

(6) Clean interior of head and bowl using a rag moistened in acetone or Trichloroethylene.

WARNING: AVOID PROLONGED SKIN CONTACT OR INHALATION OF CLEANING FLUID FUMES.

B. Installation

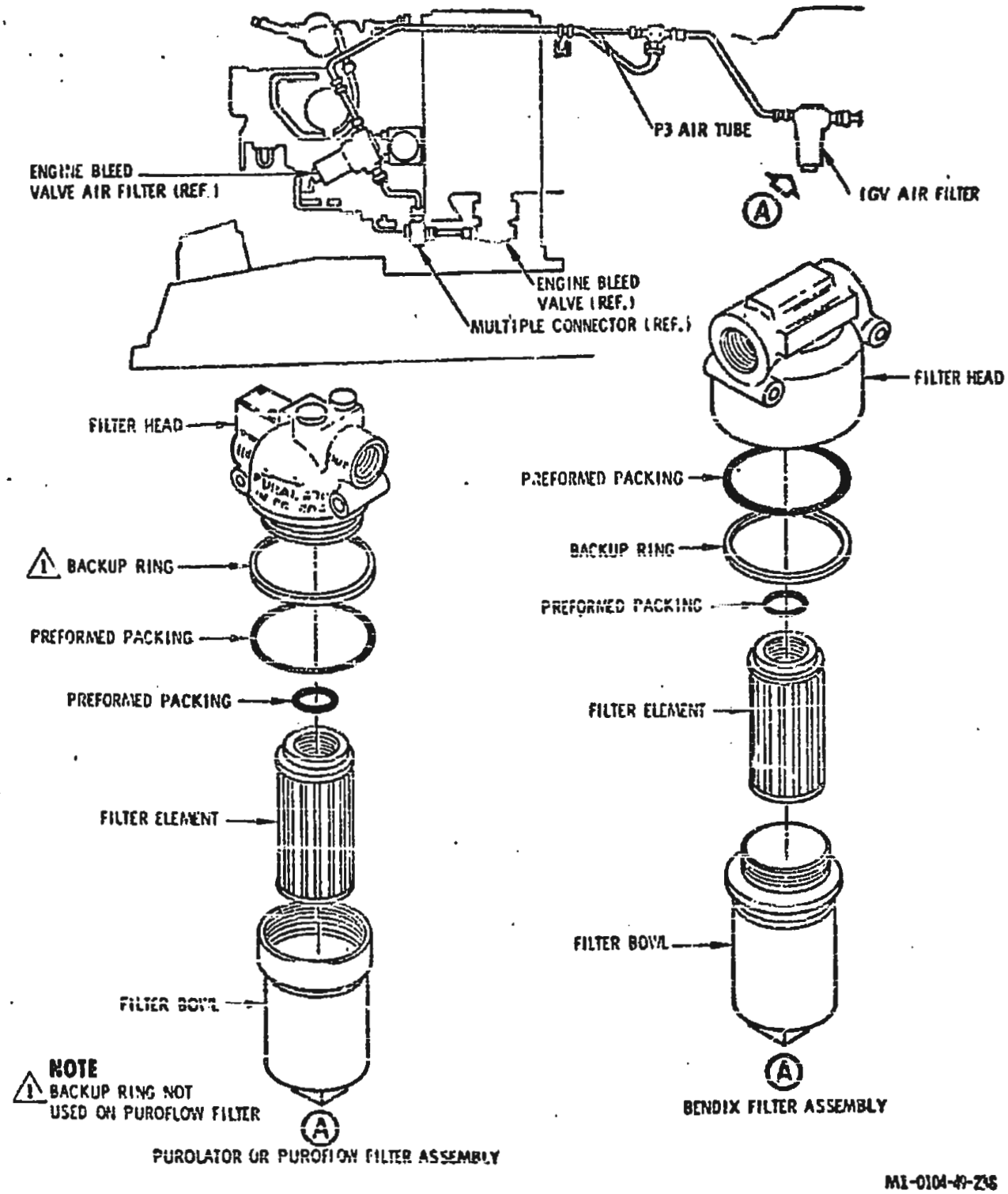
(1) Apply a light film of Dow Corning 44, or equivalent lubricant to new preformed packing; install packing and backup ring located as in Figure 401.

(2) Apply a light film of lubricant to new preformed packing and install it in the filter element. Install element in the filter head.

(3) Apply a light film of petrolatum graphite (MIL-T-5544) to threads of filter bowl and head; install bowl. Tighten bowl to a torque of 20 lb in. maximum and lock-wire with 0.032-inch diameter wire.

(4) Close APU compartment access doors.

(5) Remove tag and close circuit breakers opened in Step 2A(1).



IGV Air Filter Element - Removal and Installation
Figure 401

LOAD COMPRESSOR AIR INLET DIFFERENTIAL PRESSURE SWITCH REMOVAL INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032-in. diameter, or equivalent

Preformed Packing (Ref. Fig. 401)

2. Referenced Procedure

49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker BAT PWR (B10).

(2) Locate differential pressure switch next to IGV air filter on left side of APU (Ref. Fig. 401).

(3) Disconnect electrical connector JS17.

(4) Disconnect inlet duct pressure sensing line.

(5) Remove differential pressure switch attach bolts and separate switch from the IGV filter support bracket.

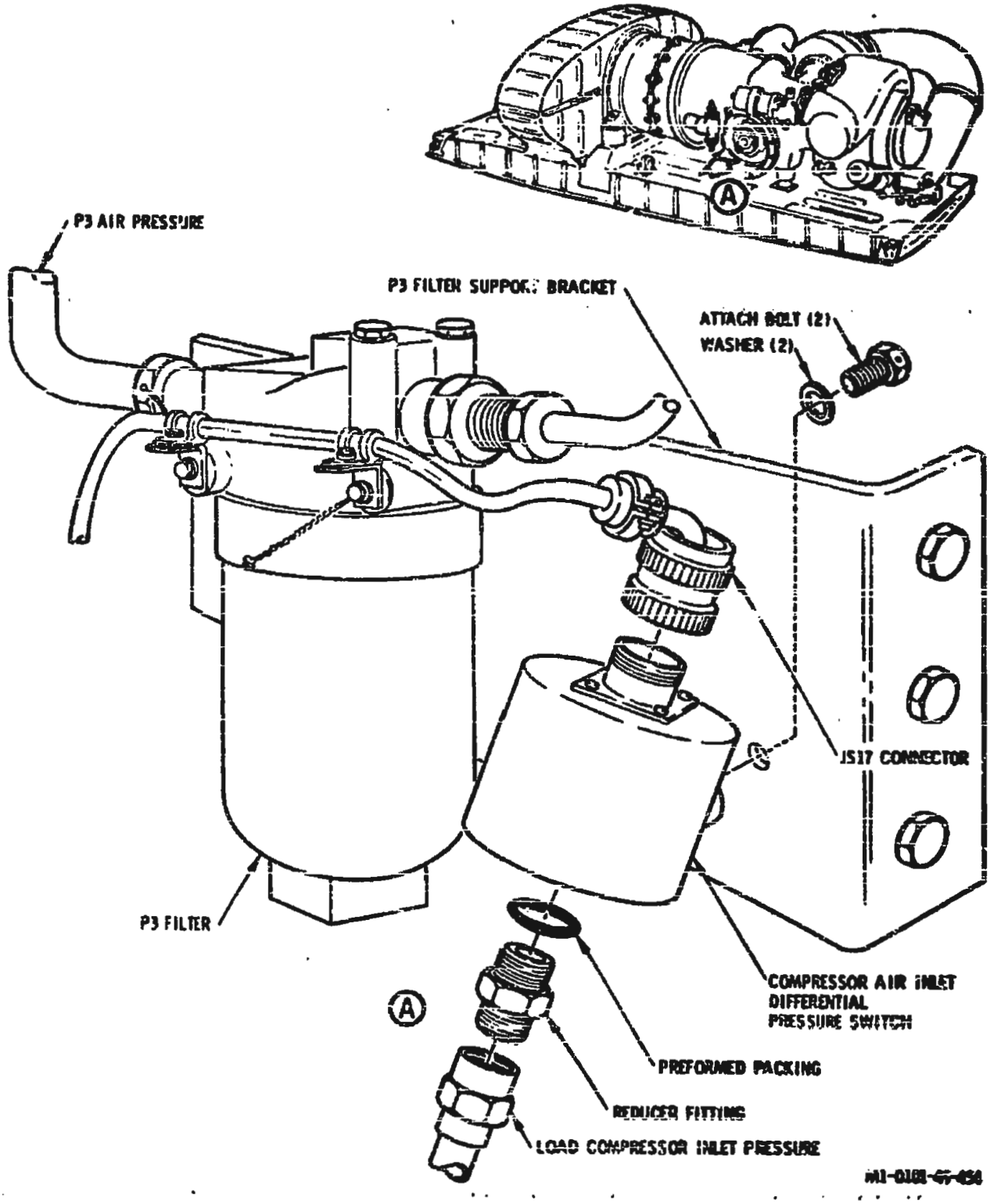
(6) Remove reducer fitting from removed switch and retain for reinstallation on new switch.

B. Installation

(1) Verify circuit breaker opened in Step 3A(1) is open and tagged.

(2) Install new preformed packing on reducer fitting and install fitting in switch low pressure sensing port. If Consolidated Controls Corporation switch is being installed, remove plastic shipping port from high pressure port marked HI. If Sierra Engineering Corporation switch is being installed, be certain ambient air pressure port is open to atmosphere.

R



R R Load Compressor Inlet Flow Differential Pressure Switch
Figure 401

(3) Install pressure differential switch on IGV filter support bracket. Tighten attach bolts to torque of 20 to 30 lb in. and install lock-wire (Ref. Fig. 401).

(4) Connect inlet duct pressure sensing line. Tighten tube nut and lock-wire nut using 0.032-inch diameter wire.

CR (5) Install electrical connector JS17.

(6) Close circuit breaker opened in Step 3A(1).

(7) Operate APU (Ref. 49-00-01). There must be no automatic shutdown of APU.

C 4. Inlet Duct Pressure Differential Switch Deactivation

C A. All inlet duct differential switches have a jumper wire installed in the APU harness connecting contracts A and B of the switch together. This eliminates nuisance shutdown of the APU caused by a troublesome and redundant set of contacts within the differential switches.

C B. There are two interchangeable differential switches stocked.

C (1) One switch is manufactured by Consolidated Controls, is gray in color, and has only one opening on the bottom of the switch for connecting the inlet air line.

C (2) The other switch is manufactured by Sierra, is black in color, and has two openings in the bottom of the switch. The openings are identified on the switch as "HI" and "LO". The correct installation is with the inlet air line connected to the outboard opening, the one identified as "LO".

LOAD COMPRESSOR AIR INLET DIFFERENTIAL PRESSURE SWTICH ADJUSTMENT AND TEST

1. General

The following procedure includes instructions for functionally checking an installed load compressor air inlet differential pressure switch.

2. Equipment and Materials

R Pneumatic system tester capable of applying negative pressure to component test port

Volt-Ohm-Milliameter, Simpson Model 260-6M, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.020-inch diameter, or equivalent

3. Functional Test

R A. Functionally check the differential pressure switch as
R follows:

R (1) Disconnect the low pressure sensing line at the bottom
R of the differential pressure switch and connect line
R from pneumatic tester.

R (2) Disconnect JS17 connector and hold ohmmeter probes on
R switch contacts A and B. There must be continuity
R between normally closed switch contacts (pins A and B).

R (3) Connect ohmmeter probes between normally open switch
R contacts (pins A and C). There must be no continuity
R between pins A and C.

R (4) Gradually reduce the air pressure at the sensing port
R and by observing the ohmmeter, determine if the
R following results occur:

R (a) For switches manufactured by Consclidated Controls
R Corp., continuity between the A and C contacts
R must occur at a negative pressure of -4.7 (±2.0)
R psig with ambient temperature between -65° to
R +140°F (-54° to +60°C).

R (b) For switches manufactured by Sierra Engineering
R Corp., continuity between the A and C contacts
R must occur at a negative pressure of -5.0 (±3.0)

psig with ambient temperature between -65° to +140°F (-54° to +60°C).

(5) Gradually allow the low pressure port to return to atmospheric pressure. Continuity between the A and B contacts must occur at a negative pressure not more than 3.0 psig less than the pressure at which the A and B contacts opened in Step 4(a) or (b). The A and C contacts must open at a pressure not more than 3.0 psi from the closing pressure.

(6) If the switch does not operate within these requirements, replace the switch.

(7) Remove the tester and reconnect the low pressure sensing line.

CR (8) Connect JS17 connector.

CHIP DETECTOR - INSPECTION AND CHECK

NOTE: When checked with a 500-volt dc megohmmeter, resistance between the center electrode and shell of the chip detector is normally more than 2 megohms. A reading less than 2 megohms indicating continuity across the magnetic elements, warrants removal of the plug for inspection.

1. Equipment and Materials

R Preformed packing (Ref. Fig. 601)

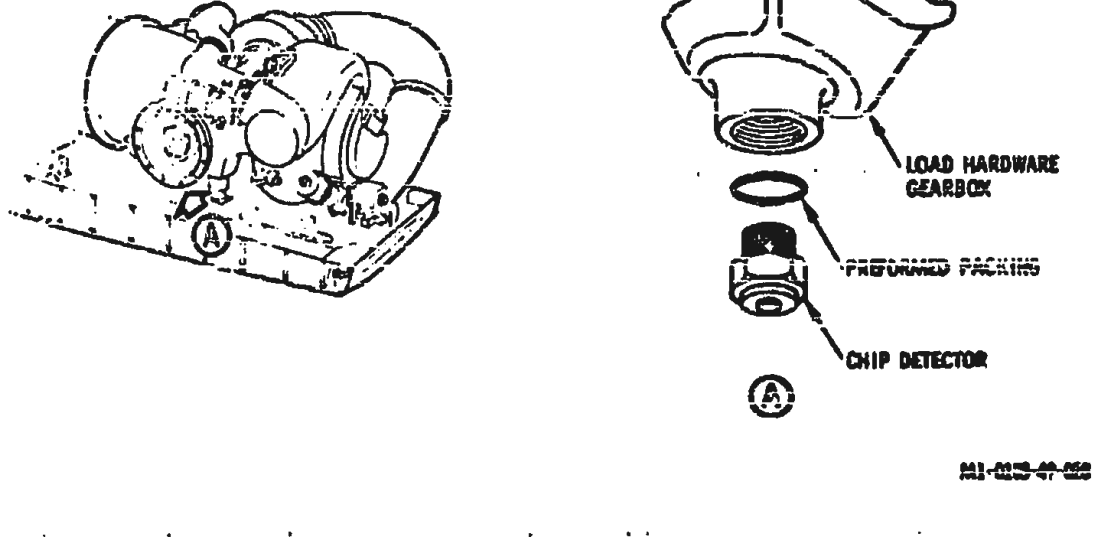
Petroleum jelly

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Drain pan

2. Referenced Procedure

12-12-41 Auxiliary Power Unit - Oil Replenishing



Magnetic Chip Detector - Removal and Installation
Figure 601

R 3. Inspection/Check

R A. Chip Detector

R (1) On Flight Engineer/Second Officers aft circuit breaker R panel CB3, zone 215, open and tag circuit breakers B9 R through B17.

R (2) Place drain pan beneath the load hardware gearbox (Ref. R Fig. 401).

R (3) Remove detector and drain residual oil from load R hardware gearbox. Discard preformed packing.

R (4) Check the magnetic drain plug for presence of metallic R chips or slivers large enough to bridge the gap of the R magnet. Fuzz build-up, indicative of normal gear wear, R is acceptable; however, it may obscure possible slivers R or chips, or may even take on the appearance of a R sliver as it builds up along the magnetic lines of R force. Remove the fuzz from the plug and rub it R between the fingers. Remove APU if any slivers or R chips larger than 0.100 inch in any dimensions are R found.

R (5) Clean chip detector in solvent and blow dry with R compressed air.

R (6) Lubricate new preformed packing with petroleum jelly R and install on chip detector.

R (7) Install chip detector.

R (8) Torque chip detector 25 (±5) lb in. and install R lock-wire.

R (9) Check APU oil quantity and replenish as necessary to R restore oil quantity to operating level (Ref. R 12-12-41).

R (10) Remove tags and close circuit breakers opened in Step R 3A(1).

LOAD COMPRESSOR AIR INLET DUCT REMOVAL AND INSTALLATION

1. Referenced Procedures

R	6-40-00	Exterior Access Doors.
	20-21-02	Ducts - Electroform Nickel
	20-51-02	Preparation for Installation of Mechanical Fasteners
	49-00-01	Auxiliary Power Unit (QEC) - Removal and Installation
R	SB49-042	Load Compressor Air Inlet Duct Modification

2. Removal/Installation

A. Removal (Air Inlet Duct Elbow)

CAUTION: BEFORE ENTERING AFTERBODY AREA, ZONE 316, INSTALL CONTROL COLUMN AND TRIM WHEEL LOCK BA80-101.

R (1) Remove APU (Ref. 49-00-01).

(2) Remove compartment insulation blanket at air inlet duct elbow.

(3) Remove inlet duct elbow-to-compartment wall fasteners.

(4) Open afterbody access door 317BB and gain access to the air inlet duct at FS 1982, zone 318, through the afterbody area above the horizontal stabilizer center
R section (Ref. 6-40-00).

(5) Remove air inlet duct-to-elbow coupling clamp.

(6) Remove elbow by extracting it from its installed position into the APU compartment.

B. Installation (Air Inlet Duct Elbow)

CAUTION: VERIFY THAT CONTROL COLUMN AND TRIM WHEEL LOCK INSTALLED IN STEP 2A HAS NOT BEEN REMOVED.

(1) In APU compartment, zone 319, insert elbow through the aft APU compartment bulkhead and engage it to the air inlet duct-to-elbow coupling seal in zone 318.

NOTE: If attach screws hole in elbow flange do not align with holes in compartment wall, the flange holes may be slotted 0.32 inch in each direction (Ref. SB 49-042).

(2) Install the elbow-to-compartment wall attach washers and screws.

(3) In zone 318, install inlet duct coupling clamp. Tighten clamp to a torque of 35 to 50 lb in.

(4) Install insulating blanket removed in Step 2A(2).

(5) Reinstall APU (Ref. 49-00-01).

R (6) Close access door 3178B (Ref. 6-40-00).

(7) Remove control column and trim wheel lock BA80-11.

R LOAD COMPRESSOR AIR INLET DUCT - INSPECTION AND CHECK

R 1. Equipment and Materials

R Flashlight

R Inspection mirror

R 2. Inspection/Check

R A. Load Compressor Air Inlet Duct

R (1) On Flight Engineer/Second Officers aft circuit breaker
R panel C83, zone 215, open and tag circuit breakers APU
R POWER circuit breakers (B9 through B17).

R (2) Open APU access door 319DR.

R (3) At load compressor air inlet, loosen two clamps and
R move duct coupling boot aft to expose interior of air
R inlet duct.

R (4) Inspect load compressor, inlet guide assembly, and air
R inlet duct for general condition and evidence of damage
R from foreign object ingestion. Inspect airflow vanes
R in duct elbow for general condition.

R (5) Reinstall boot and boot clamps. Tighten clamps to 20
R lb-inch torque.

R (6) Close APU access door.

R (7) Remove tags and close circuit breakers opened in Step
R 2A(1).

LOAD COMPRESSOR AIR INLET DUCT - APPROVED REPAIRS

1. General

The following procedure includes an approved method for repairing air inlet duct elbows that have failed in service. Failures have been reported as cracks in the surface of the
R airflow guide vanes, racks in the elbow assembly wall at the
R guide vane leading edge attach tabs, and separation of the duct
R mounting flange attach tabs. Figure 801 illustrates the method used to repair the elbow. Cracked airflow guide vanes should be replaced with P/N 1505534-115 and 1505534-137 vanes in accordance with SB49-037 which, if not accomplished, should be done concurrently with the elbow repair.

2. Equipment and Materials

Doubler - Locally fabricate from 0.032, Type 301, 1/4 Hard CRES

Plug - Locally fabricate from 0.032, Type 301, 1/4 Hard CRES

Pin, HLT 110-6-2 (Locally procured)

Collar, HLT 294LP-6 (Locally procured)

Rivets, MS 20615-3M (Locally procured)

Washer, 1505534-151

Control Column and Trim Wheel Lock, BA80-101 (Ref. G/ITEL 27-41-01)

3. Referenced Procedures

20-51-02	Preparation for and Installation of Mechanical Fasteners
49-00-01	Auxiliary Power Unit (QEC) - Removal and Installation
R 49-51-05 R	Load Compressor Air Inlet Duct - Removal and Installation

4. Approved Repairs

R A. Cracked Airflow Guide Vanes and Elbow

(1) Remove the airflow guide vane fastened to the damaged area.

(2) Make circular cutout of sufficient diameter to remove the damaged area (Ref. Fig. 801).

(3) Using 0.032 Type 301, 1/4 hard CRES, fabricate doubler to match contour of elbow. Doubler diameter must be of sufficient size to allow a rivet pattern having an edge distance of 0.31 in. at edges of the cutout and doubler and, on doublers covering a cutout greater than 1.5 in., a spacing between rivet rows of 0.62 in.

(4) On repairs covering a hole up to 1.5 in., fabricate a plug of identical material as the doubler and attach it to the doubler with MS 20615-3M rivets (Ref. Fig. 801).

(5) Reinstall airflow guide vane.

(6) Hold doubler in its installed position and mark the location of the airflow guide vane tab and fastener holes on the inner surface of the doubler.

(7) Drill the doubler to accurately match the guide vane fastener holes. (The vane Hi-Lok attach fasteners will be used to secure the doubler at this location.)

(8) Layout the doubler rivet pattern. Pilot drill these holes and transfer the pattern to the elbow (Ref. 20-51-02).

(9) Install the doubler using MS 20615-3M rivets. Pick up the vane attach tab using Hi-Lok fasteners.

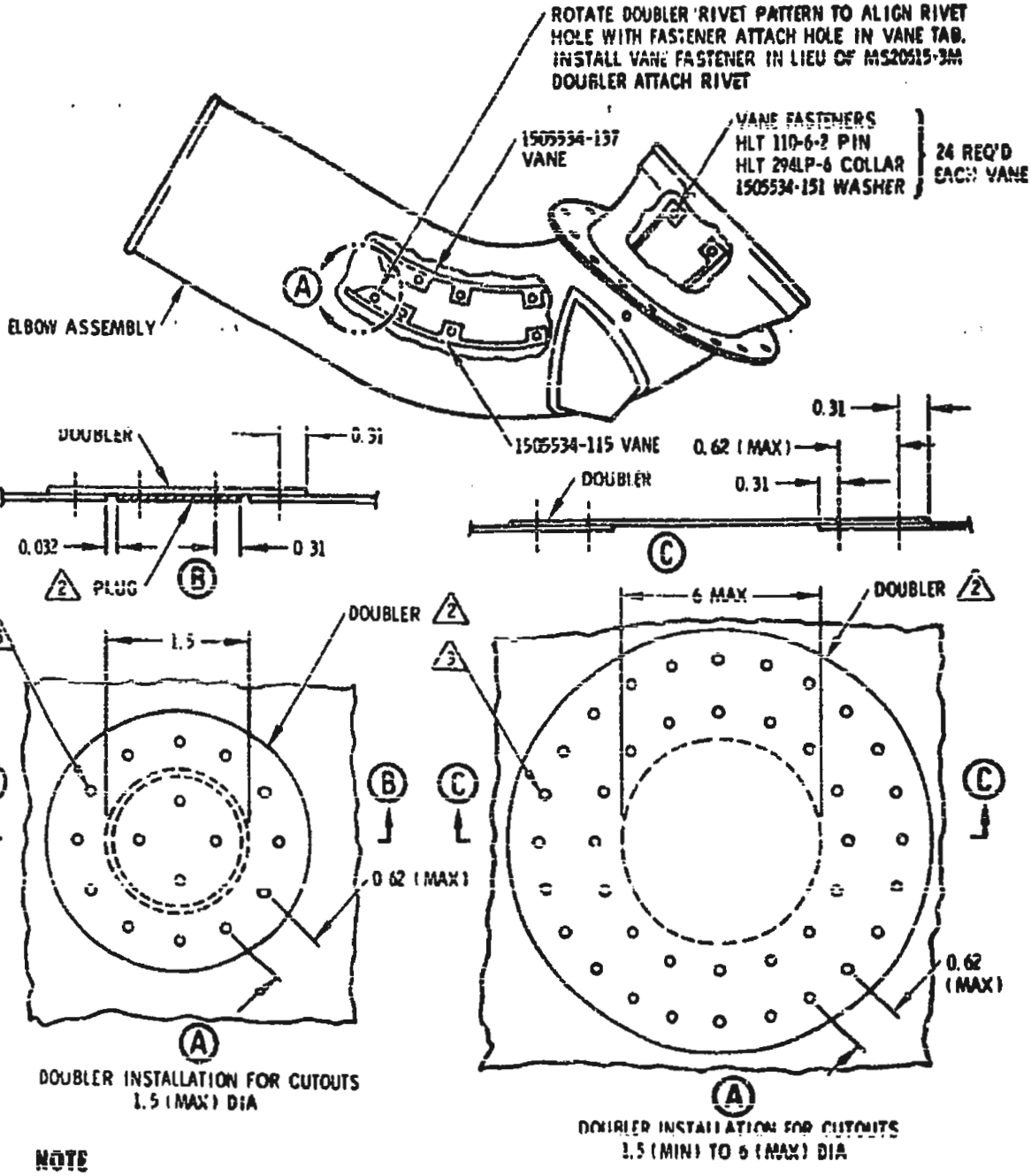
R B. Separated Mounting Flange Attach Tabs

R (1) Clean out brazed filler material at each loose tab.

R (2) Secure tab to elbow using one, or a combination of the
R following two methods.

R (a) Install three each MS20615-3M (Monel) rivets (Ref.
R 20-51-02).

R (b) Rebraze tab to elbow using AMS 4766, or equivalent
R 15 per cent MN/AG (Ref. 20-21-02).


ROTATE DOUBLER RIVET PATTERN TO ALIGN RIVET HOLE WITH FASTENER ATTACH HOLE IN VANE TAB. INSTALL VANE FASTENER IN LIEU OF MS20515-3M DOUBLER ATTACH RIVET
1505534-137 VANE
VANE FASTENERS
HLT 110-6-2 PIN
HLT 294LP-6 COLLAR
1505534-151 WASHER
24 REQ'D EACH VANE
ELBOW ASSEMBLY
1505534-115 VANE
DOUBLER
0.31
0.62 (MAX)
0.032
PLUG
DOUBLER INSTALLATION FOR CUTOUTS 1.5 (MAX) DIA
DOUBLER INSTALLATION FOR CUTOUTS 1.5 (MIN) TO 6 (MAX) DIA

NOTE

1. ALL DIMENSIONS ARE IN INCHES
2. FABRICATE PLUG AND DOUBLER FROM 0.032 TYPE 301, 1/4 HARD CRES
3. INSTALL DOUBLER AND PLUG USING MS20615-3M RIVETS. LAYOUT RIVET PATTERN TO MAINTAIN 0.31 EDGE DISTANCE AND 0.62 (MAX) SPACING BETWEEN RIVETS

M1-0100-49-523

Air Inlet Duct Elbow Repair
Figure 801

EFFECTIVITY: ALL

ADJUSTABLE ORIFICE FILTER ELEMENT - REMOVAL AND INSTALLATION

1. General

An APU load compressor controller adjustable orifice filter element is installed in a bulb-shaped cover next to the load compressor controller. Replaced filter elements are reusable and should be shipped to the operators appropriate shop facility for cleaning and restocking.

2. Equipment and Materials

R Element, Filter (Ref. Fig. 401)

R Preformed packing (Ref. Fig. 401)

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breakers B9 through B17.

(2) Open left forward and aft APU compartment access doors.

R R (3) Loosen two filter cover attach screws. Remove cover, spring, and filter element (Ref. Fig. 401).

(4) Remove and discard pre-formed packing installed in groove at base of cover.

B. Installation

(1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

R R (2) Install new preformed packing in internal groove at base of new filter element (Ref. Fig. 401).

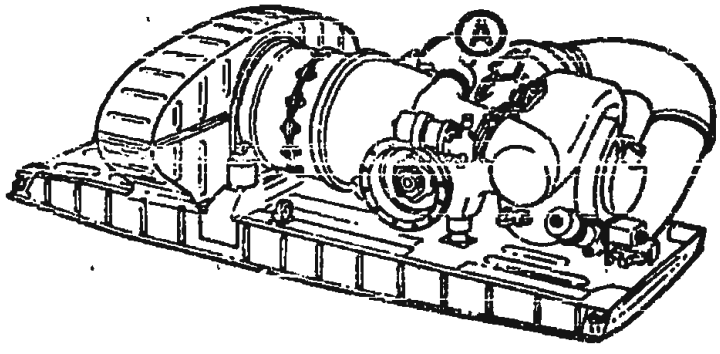
(3) Install new preformed packing in external groove at base of filter cover.

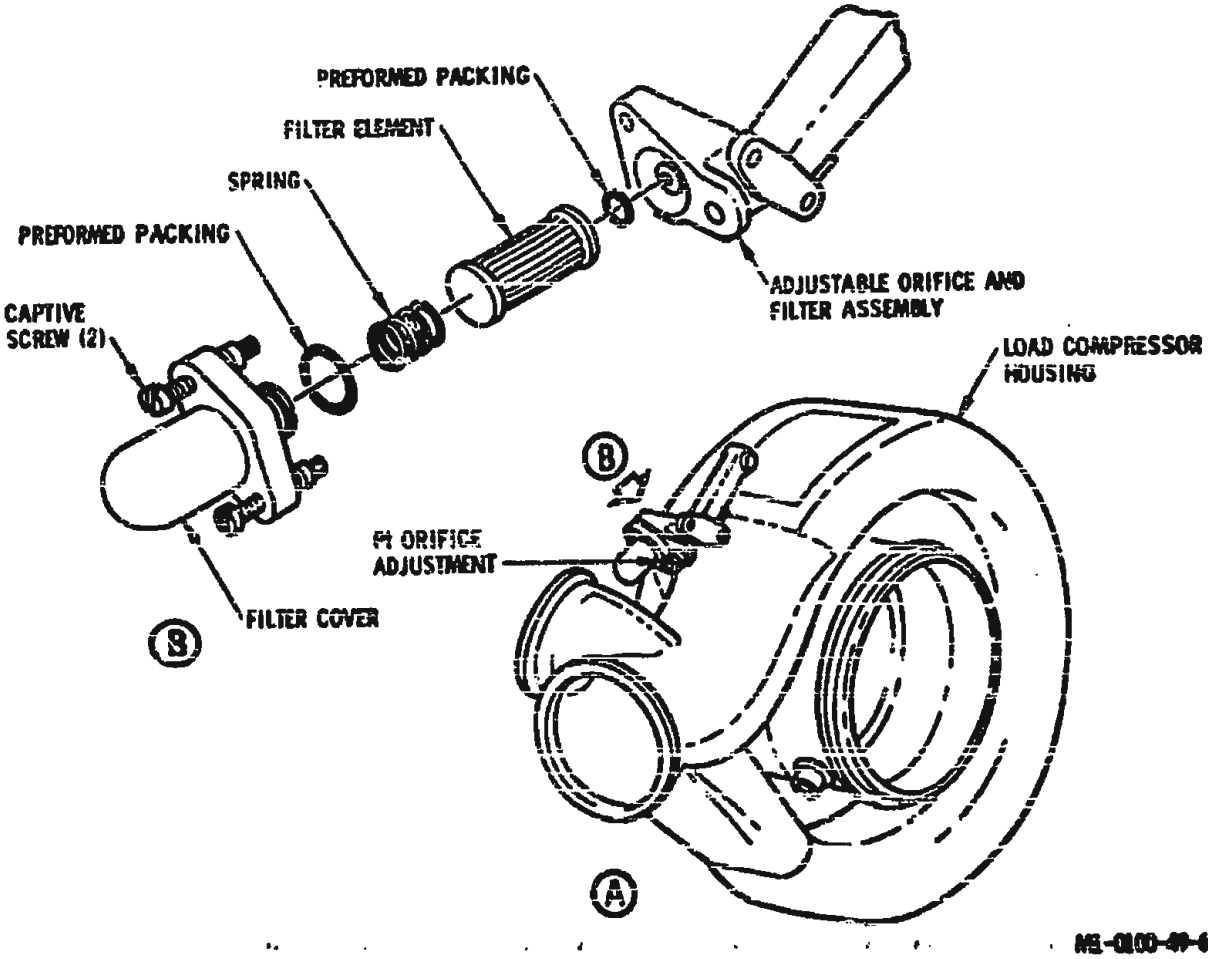
(4) Place filter element in its installed position.

R R (5) Place filter cover in its installed position with spring between filter element and recess at end of filter cover.

R R (6) Engage filter attach screws. Tighten attach screws to a torque of 15 to 20 lb in.

R R (7) Close APU access doors. Be certain fluid scupper catcher is swung aft against APU door.





ME-0100-49-006

R Adjustable Pi Orifice Filter Element - Removal and Installation
R Figure 401

R EFFECTIVITY: ALL
R
001B

APU POWER PLANT CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

Control of the APU during all phases of its operation is primarily an automatic electrically controlled function. The control system consists of an APU ELECTRONIC CONTROL UNIT (ECU) located in the Air Electronic Equipment Area (AEEA), an APU CONTROL panel located at the Flight Engineer/Second Officers station, an external control panel in the underside of the fuselage, an APU EQUIPMENT AND POWER CONTROL PANEL located in the AEEA next to the ECU, and various power application relays and remote control circuit breakers (RCCB's) the mid electrical service center (MESC). APU mounted sensors and pneumatically operated fuel and load compressor control components operate in conjunction with the ECU to provide automatic control of APU operation during the APU start, operating, and stop sequences.

Automatic shutdown provisions are incorporated which will terminate APU operation in event one or more of the following conditions occur:

A. A free turbine speed greater than 110 percent RPM (N2 OVERSPEED)

B. High engine oil temperature (245 degrees F)

C. High engine (TGT) temperature (1060 degrees C)

D. Low engine oil pressure (Less than 50 psi)

E. Foreign object blockage of the load compressor air inlet duct

A shutdown incurred by one or more of the above conditions is indicated on the APU CONTROL PANEL by an appropriate fault flag indicator or advisory light.

An APU shutdown will also be incurred by one or more of the following operational malfunctions:

R A. Loss or interruption of ECU power

R B. Loss of Ng tachometer signal

R C. Loss of NfA or NfB free turbine speed sensor signals

R D. Fire detect input signal (Autofire shutdown)

2. APU Controls and Indicators

A. General

Controls and indicators used in operating the APU (other than the Ng and TGT indicators described in Section 49-71-00) are contained on the APU CONTROL panel (Ref. Fig. 1) and APU external control panel (Ref. Fig. 2). These controls and indicators are supplemented by the following indicators:

(1) APU EMERGENCY SHUTOFF PRI and SEC disagreement light indicators

These indicators are located on the FE/SO FUEL SYSTEM panel and provide:

(a) In-transit light indication of primary and secondary emergency fuel shutoff valve operation (Ref. 28-25-00)

(b) Continuous disagreement light indication if the respective primary or secondary fuel shutoff valve position is not in agreement with the selected circuit function

R (2) Elapsed Time Indicator.

A digital counter elapsed time indicator is mounted on a bracket attached to the APU engine accessory gearbox case. The indicator displays hours of APU engine running time.

NOTE: The elapsed time indicator will continue to run after an APU shutdown as long as the APU MASTER POWER switch is on and 115V AC power is available at PASSENGER SERVICE BUS 1B.

B. APU MASTER POWER Switch

(1) Description

Aircraft battery bus power to the APU continuous power distribution and control circuits is acquired through a battery power RCCB which is remotely controlled by an electrically latched MASTER POWER switch (Ref. Fig. 1). Voltage from the continuous power distribution circuitry is applied through a POWER ON switchlight on the external control panel to the holding coil of the switch and through contacts of the switch to the APU CONTROL panel as APU master power. Master power can be turned off by manually actuating the switch to the OFF

position or by interrupting the holding coil voltage at the POWER ON switchlight. However, the POWER ON switchlight cannot be used for this purpose after an APU start is initiated and the air inlet door has opened as a second holding coil voltage circuit is then made through a MASTER POWER RESET relay and is maintained until the APU is shutdown and the door has closed.

C. Start Switch

(1) Description

The APU START switch (Ref. Fig. 1) is a momentary contact switchlight which, when depressed, initiates the APU start cycle.

D. STOP Switch

(1) Description

The APU STOP switch (Ref. Fig. 1) is a momentary contact pushbutton switch which, when depressed, initiates an APU shutdown. It does this by interrupting the latching voltage applied to APU STOP relay (4961-K1) during the APU start.

The switch also completes a circuit to the APU generator control unit which trips the generator off the line.

E. BLEED AIR SOV Switchlight

(1) Description

The BLEED AIR SOV switchlight (Ref. Fig. 1) commands the APU bleed air shutoff valve to the open and closed positions. When in the released (unlatched) position, the switchlight opens the APU bleed air shutoff valve solenoid control circuit. The valve position OPEN light is off and the load compressor select switch has no effect on compressor mode operation. The IGV MODE SEL relay (4961-K8) is deenergized and the ECU commands the APU load compressor to operate in MIN MODE only. An engine start using APU air cannot be made until the APU bleed air shutoff valve is open.

With the BLEED AIR SOV switchlight depressed (latched), the bleed air shutoff valve solenoid is energized and the valve is pneumatically opened. The valve position switch closes and applies 28V dc to the valve OPEN light and compressor mode select switch. The

compressor mode select switch may now be used to select NORM and MAX MODE operation. MAX MODE operation will be automatically initiated by the respective engine ground start relay which is wired in parallel with the compressor mode select switch. With the valve closed, the internal valve position switch is open and the power circuit to the valve OPEN light and load compressor select switch is opened.

F. Load Compressor Mode Select Switch

(1) Description

The load compressor mode select switch (Ref. Fig. 1) is used to select the APU load compressor operating mode. With the BLEED AIR SOV switchlight released (unlatched), the APU bleed air shutoff valve is closed and the electrical power circuit to the compressor mode select switch (and shutoff valve OPEN light) is opened by the bleed air shutoff valve position switch. The IGV MODE SEL relay (4961-K8) is deenergized and the ECU commands the APU to operate in MIN MODE only. The compressor mode select switch will have no effect on compressor mode operation.

With the BLEED AIR SOV switchlight depressed (latched), the APU bleed air shutoff valve solenoid will be energized and the valve will be pneumatically opened. Electrical power is now applied through the valve position switch to the compressor mode select switch and the contacts of the engine ground start relays that control the IGV MAX SEL relay (4961-K9). The compressor mode select switch may now be used to select NORM and MAX MODE operation. An energized engine ground start relay will override the compressor mode select switch and command MAX MODE operation regardless of compressor mode select switch position.

G. AUTO FIRE SHUTDOWN Switchlight

(1) Description

The AUTO FIRE SHUTDOWN switchlight (Ref. Fig. 1) provides the Flight Engineer/Second Officer a means of overriding the APU autofire shutdown circuitry. In the air, with APU MASTER POWER applied and the switchlight in its guarded (latched) position, the autofire shutdown circuit is armed and the ARMED light in the switchlight is on. Depressing (unlatching) the switchlight will deactivate the autofire shutdown circuitry and put out the ARMED light. Shutdown of the APU and extinguishing of an APU compartment fire is

then strictly a manual operation controlled by the FE/SO through use of the APU FIRE PULL handle. When on the ground, the autofire shutdown circuit is armed whenever APU MASTER POWER is applied (regardless of switchlight position), and the ARMED light will be on.

H. Operational Status Indicators

(1) General

Eight operational status lights are located on the APU CONTROL panel (Ref. Fig. 1).

(2) DONT LOAD Light

(a) Description

The DONT LOAD light comes on when power is first applied to the ECU and remains on during the APU start until free turbine speed (Nf) exceeds 95 percent. The DONT LOAD light will also come on whenever Nf exceeds 105 percent or drops below 95 percent.

(3) BATTERY CONDITION Light

(a) Description

This light comes on to provide a warning indication of an overheated or shorted-cell battery condition.

This light comes on to provide a warning indication of an overheated or shorted-cell battery condition. The indicator is essentially a part of the aircraft DC power system. It is installed on the APU CONTROL panel since an APU start is a critical battery load and in most cases is the first load on the battery when applying power to the aircraft.

R

(4) DOOR IN TRANSIT Light

(a) Description

The DOOR IN TRANSIT light is normally on only when the vent ejector doors are operating to the open or closed positions. If the light remains on, a malfunctioning door actuating system or faulty light circuit is indicated.

(5) FUEL FILTER Light (Not applicable to aircraft having APU P/N 738089-20 thru -99 and earlier units with HS SB49-105)

(a) Description

The FUEL FILTER light is on whenever the APU clogged fuel filter switch senses a differential pressure of 1.25 psid across the APU engine fuel filter.

(6) LOW OIL QUANTITY Light

(a) Description

The LOW OIL QUANTITY light indicates that the APU engine oil tank level is approximately 3.5 quarts below the normally serviced full operating level.

(7) MAX MODE Light

(a) Description

R The MAX MODE light indicates that the load
R compressor air inlet guide vanes are close to or
R at full open position. The light is turned on by a comparator circuit in the ECU which senses full open IGV position as a function of IGV feedback potentiometer voltage level when the IGVs are full open.

(8) INLET FLOW Light

(a) Description

The INLET FLOW light indicates that an automatic shutdown of the APU is due to a restriction of air flow in the load compressor air inlet duct. The APU may be restarted after the MASTER POWER switch is cycled off, then on.

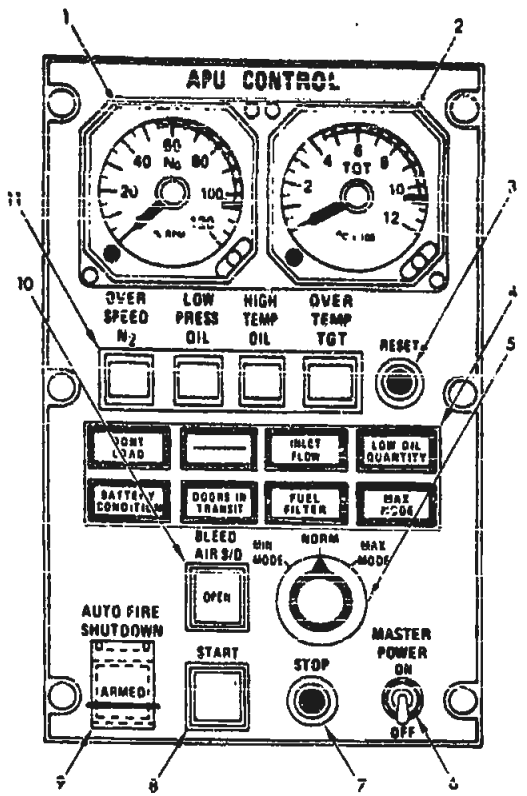
I. Fault Flag Indicators

(1) Description

An automatic shutdown cycle is initiated by the ECU whenever one (or more) faults, indicated by the following fault flag indicators, occurs:

OVERSPEED N2

LOW PRESS OIL



NOTE

1. FUEL FILTER LIGHT INDICATION IS INACTIVE IF APU CLOGGED FUEL FILTER SWITCH IS DEACTIVATED, OR REMOVED IN ACCORDANCE WITH HS SB 49-105.
   LAC SB 49-045 DONE CONCURRENTLY WITH OR SUBSEQUENT TO HS SB 49-105 DELETES FUEL FILTER LIGHT LEGEND.
2. TO IMPROVE APU RELIABILITY, MIN MODE SHOULD BE USED FOR NORMAL AIR CONDITIONING OPERATIONS (WITH 2 OR 3 PACKS) EXCEPT WHENEVER CABIN COOLING OR HEATING REQUIREMENTS CAN ONLY BE MET BY USE OF NORM MODE. AS A ROUGH GUIDE, MIN MODE, 2 PACK OPERATION WILL USUALLY BE ADEQUATE FOR AIR CONDITIONING IN AMBIENT TEMPERATURES BETWEEN +15°C (59°F) AND +27°C (80°F), PROVIDED DUCT PRESSURE IS NORMAL (8-10 PSI MIN).

1 Ng RPM INDICATOR

INDICATES APU GAS GENERATOR RPM. NORMAL OPERATING RANGE IS 90% TO 100%. TEST BUTTON DRIVES POINTER TO 100% READING.

2 TGT INDICATOR

INDICATES ENGINE OPERATING TEMPERATURE. NORMAL OPERATING RANGE IS 700 TO 1050°C. TEST BUTTON DRIVES POINTER TO 1100°C.

3 RESET BUTTON

DEPRESSING RESET BUTTON CLEARS FAULT FLAGS (ITEM 11). IT DOES NOT CLEAR INDICATED FAULT.

4 APU STATUS LIGHTS

- DON'T LOAD LIGHT
  WHEN ON, LIGHT INDICATES THAT APU IS NOT AT NORMAL OPERATING SPEED AND SHOULD NOT BE LOADED. THE LIGHT IS NORMALLY ON WHEN FREE TURBINE SPEED IS LESS THAN 95% OR MORE THAN 105% RPM.
- INLET FLOW LIGHT INDICATES THAT APU SHUTDOWN IS CAUSED BY OBSTRUCTION IN LOAD COMPRESSOR AIR INLET DUCT.
- LOW OIL QUANTITY LIGHT
  WHEN ON, APU OIL TANK QUANTITY IS 2 QUARTS BELOW NORMAL FULL LEVEL.
- BATTERY CONDITION LIGHT
  WHEN ON, AIRCRAFT BATTERY IS FAULTY (SHORTED CELL OR OVERHEATED).
- DOORS IN TRANSIT LIGHT
  COMES ON TO INDICATE APU AIR INLET AND VENT AIR EJECTOR DOORS ARE IN TRANSIT TO OPEN OR CLOSED POSITION. IF LIGHT STAYS ON, LIGHT CIRCUIT IS FAULTY OR DOORS ARE NOT IN FULLY OPEN OR CLOSED POSITION.
- FUEL FILTER LIGHT (1)
  WHEN ON, APU ENGINE FUEL INLET FILTER IS CLOGGED. LIGHT IS ACTIVATED BY FUEL FILTER DIFFERENTIAL PRESSURE SENSING SWITCH.
- MAX MODE LIGHT
  WHEN ON, LOAD COMPRESSOR INLET GUIDE VANES ARE COMMANDED TO FULL OPEN POSITION AND APU IS OPERATING IN MAX MODE.

5 MODE SELECTOR SWITCH

SELECTS APU OPERATIONAL MODE REQUIRED TO MEET PNEUMATIC LOAD REQUIREMENTS:

- MIN (2)
  NORMALLY SELECTED WHEN OUTPUT DEMANDED FROM THE LOAD COMPRESSOR IS LOW AND THE APU IS BEING OPERATED PRIMARILY TO PROVIDE ELECTRICAL POWER.
- NORM
  SELECTS INCREASED AIR FLOW MODE FOR OPERATION OF ECS AIR PACKS OR ATM.
- MAX MODE
  DEMANDS MAXIMUM LOAD COMPRESSOR OUTPUT FOR CHECKING ENGINE THRUST REVERSERS AND RAPID RESPONSE TO ECS DEMANDS. MAX MODE OPERATION IS AUTOMATICALLY SELECTED DURING AIRCRAFT ENGINE STARTING.

NOTE

THE APU CONTROL SYSTEM IS DESIGNED TO AUTOMATICALLY PROVIDE THE ELECTRICAL GENERATOR PRIORITY OVER ENGINE POWER OUTPUT REGARDLESS OF MODE SELECTOR SWITCH POSITION AND LOAD COMPRESSOR DEMANDS.

6 MASTER POWER SWITCH

APPLIES AIRCRAFT BATTERY BUS VOLTAGE TO THE APU CONTINUOUS POWER CIRCUITS. THE SWITCH IS ELECTRICALLY LATCHED IN THE ON POSITION. IF THE APU IS SHUTDOWN FROM THE EXTERNAL CONTROL PANEL, THE SWITCH WILL REMAIN LATCHED UNTIL THE APU AIR INLET DOOR IS CLOSED AND EXTERNAL PANEL POWER ON SWITCHLIGHT IS DEPRESSED.

7 STOP SWITCH

DEPRESSING BUTTON OF MOMENTARY CONTACT STOP SWITCH INITIATES NORMAL SHUTDOWN OF APU BY INTRODUCING A FALSE FREE TURBINE OVERSPEED SIGNAL IN THE SHUTDOWN CIRCUITRY.

8 START SWITCH

DEPRESSING MOMENTARY CONTACT SWITCH INITIATES APU STARTING SEQUENCE (STARTER, FUEL FLOW, IGNITION).

9 AUTO FIRE SHUTDOWN SWITCHLIGHT

WHEN LATCHED IN, ARMED LIGHT COMES ON WITH APU MASTER POWER TO INDICATE ARMING OF AUTOMATIC FIRE SHUTDOWN CIRCUIT. CIRCUIT IS ALWAYS ARMED DURING GROUND OPERATIONS. WHEN AIRBORNE AND SWITCHLIGHT IS OUT (NOT LATCHED) AUTO FIRE SHUTDOWN IS INACTIVE.

10 BLEED AIR S/O SWITCHLIGHT

CONTROLS OPENING AND CLOSING OF APU COMPRESSOR BLEED AIR SHUTOFF VALVE. WHEN LATCHED IN, OPEN LEGEND IS ILLUMINATED AND VALVE IS OPEN.

11 FAULT FLAG INDICATORS

NOTE

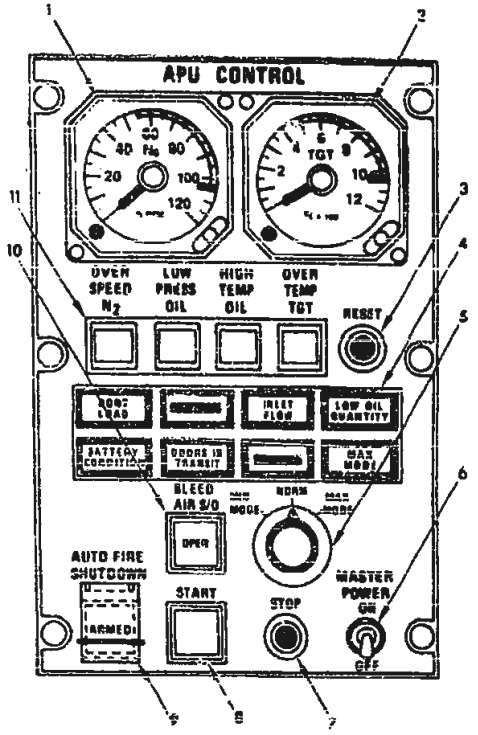
THE APPEARANCE OF ONE OR MORE OF THE FOUR FAULT FLAGS WILL BE ACCOMPANIED BY AN AUTOMATIC APU SHUTDOWN. IF MORE THAN ONE FLAG APPEARS, THE FIRST FLAG TO APPEAR IS THE SHUTDOWN FAULT.

- OVERSPEED N2
  FAULT FLAG IS TRIPPED BY A FREE TURBINE SPEED HIGHER THAN 110% OR AN N/A SPEED SENSOR FAILURE.
- LOW PRESS OIL
  ABOVE 55% Ng, FAULT FLAG IS TRIPPED IF OIL PRESSURE IS LESS THAN 50 PSIG FOR A PERIOD LONGER THAN 10 SECONDS.
- HIGH TEMP OIL
  FAULT FLAG IS TRIPPED WHENEVER ENGINE OIL TEMPERATURE EXCEEDS 245°F.
- OVERTEMP TGT
  FAULT FLAG IS TRIPPED IF TURBINE GAS TEMPERATURE EXCEEDS 760°C WHEN Ng IS LESS THAN 55% AND AT 1050°C WHEN Ng IS HIGHER THAN 55%.

M1-000-49-073

R
R

APU CONTROL Panel
Figure 1



NOTE

⚠ TO IMPROVE APU RELIABILITY, MIN MODE SHOULD BE USED FOR NORMAL AIR CONDITIONING OPERATIONS (WITH 2 OR 3 PACKS) EXCEPT WHENEVER CABIN COOLING OR HEATING REQUIREMENTS CAN ONLY BE MET BY USE OF NORM MODE. AS A ROUGH GUIDE, MIN MODE, 2 PACK OPERATION WILL USUALLY BE ADEQUATE FOR AIR CONDITIONING IN AMBIENT TEMPERATURES BETWEEN +15°C (59°F) AND +27°C (80°F), PROVIDED DUCT PRESSURE IS NORMAL (8 - 10 PSI MIN).

1 Ng RPM INDICATOR

INDICATES APU GAS GENERATOR RPM. NORMAL OPERATING RANGE IS 90% TO 100%. TEST BUTTON DRIVES POINTER TO 100% READING.

2 TGT INDICATOR

INDICATES ENGINE OPERATING TEMPERATURE. NORMAL OPERATING RANGE IS 700 TO 1090°C. TEST BUTTON DRIVES POINTER TO 1100°C.

3 RESET BUTTON

DEPRESSING RESET BUTTON CLEARS FAULT FLAGS (ITEM 11). IF DOES NOT CLEAR INDICATED FAULT.

4 APU STATUS LIGHTS

- DON'T LOAD LIGHT
  WHEN ON, LIGHT INDICATES THAT APU IS NOT AT NORMAL OPERATING SPEED AND SHOULD NOT BE LOADED. THE LIGHT IS NORMALLY ON WHEN FREE TURBINE SPEED IS LESS THAN 95% OR MORE THAN 105% RPM.
- INLET FLOW
  INLET FLOW LIGHT INDICATES THAT APU SHUTDOWN IS CAUSED BY OBSTRUCTION IN LOAD COMPRESSOR AIR INLET DUCT.
- LOW OIL QUANTITY LIGHT
  WHEN ON, APU OIL TANK QUANTITY IS 2 QUARTS BELOW NORMAL FULL LEVEL.
- BATTERY CONDITION LIGHT
  WHEN ON, AIRCRAFT BATTERY IS FAULTY (OVERHEATED).
- DOORS IN TRANSIT LIGHT
  COMES ON TO INDICATE APU AIR INLET AND VENT AIR EJECTOR DOORS ARE IN TRANSIT TO OPEN OR CLOSED POSITION. IF LIGHT STAYS ON, LIGHT CIRCUIT IS FAULTY OR DOORS ARE NOT IN FULLY OPEN OR CLOSED POSITION.
- MAX MODE LIGHT
  WHEN ON, LOAD COMPRESSOR INLET GUIDE VANES ARE COMMANDED TO FULL OPEN POSITION AND APU IS OPERATING IN MAX MODE.

5 MODE SELECTOR SWITCH

SELECTS APU OPERATIONAL MODE REQUIRED TO MEET PNEUMATIC LOAD REQUIREMENTS:

- MIN ⚠
  NORMALLY SELECTED WHEN OUTPUT DEMANDED FROM THE LOAD COMPRESSOR IS LOW AND THE APU IS BEING OPERATED PRIMARILY TO PROVIDE ELECTRICAL POWER.
- NORM
  SELECTS INCREASED AIR FLOW MODE FOR OPERATION OF ECS AIR PACKS OR ATM.
- MAX MODE
  DEMANDS MAXIMUM LOAD COMPRESSOR OUTPUT FOR CHECKING ENGINE THRUST REVERSERS AND RAPID RESPONSE TO ECS DEMANDS. MAX MODE OPERATION IS AUTOMATICALLY SELECTED DURING AIRCRAFT ENGINE STARTING.

NOTE

THE APU CONTROL SYSTEM IS DESIGNED TO AUTOMATICALLY PROVIDE THE ELECTRICAL GENERATOR PRIORITY OVER ENGINE POWER OUTPUT REGARDLESS OF MODE SELECTOR SWITCH POSITION AND LOAD COMPRESSOR DEMANDS.

6 MASTER POWER SWITCH

APPLIES AIRCRAFT BATTERY BUS VOLTAGE TO THE APU CONTINUOUS POWER CIRCUITS. THE SWITCH IS ELECTRICALLY LATCHED IN THE ON POSITION. IF THE APU IS SHUTDOWN FROM THE EXTERNAL CONTROL PANEL, THE SWITCH WILL REMAIN LATCHED UNTIL THE APU AIR INLET DOOR IS CLOSED AND EXTERNAL PANEL POWER ON SWITCHLIGHT IS DEPRESSED.

7 STOP SWITCH

DEPRESSING BUTTON OF MOMENTARY CONTACT STOP SWITCH INITIATES NORMAL SHUTDOWN OF APU BY INTRODUCING A FALSE FREE TURBINE OVERSPEED SIGNAL IN THE SHUTDOWN CIRCUITRY.

8 START SWITCH

DEPRESSING MOMENTARY CONTACT SWITCH INITIATES APU STARTING SEQUENCE (STARTER, FUEL FLOW, IGNITION).

9 AUTOFIRE SHUTDOWN SWITCHLIGHT

WHEN LATCHED IN, ARMED LIGHT COMES ON WITH APU MASTER POWER TO INDICATE ARMING OF AUTOMATIC FIRE SHUTDOWN CIRCUIT. CIRCUIT IS ALWAYS ARMED DURING GROUND OPERATIONS. WHEN AIRBORNE AND SWITCHLIGHT IS OUT (NOT LATCHED) AUTO FIRE SHUTDOWN IS INACTIVE.

10 BLEED AIR S/O SWITCHLIGHT

CONTROLS OPENING AND CLOSING OF APU COMPRESSOR BLEED AIR SHUTOFF VALVE. WHEN LATCHED IN, OPEN LEGEND IS ILLUMINATED AND VALVE IS OPEN.

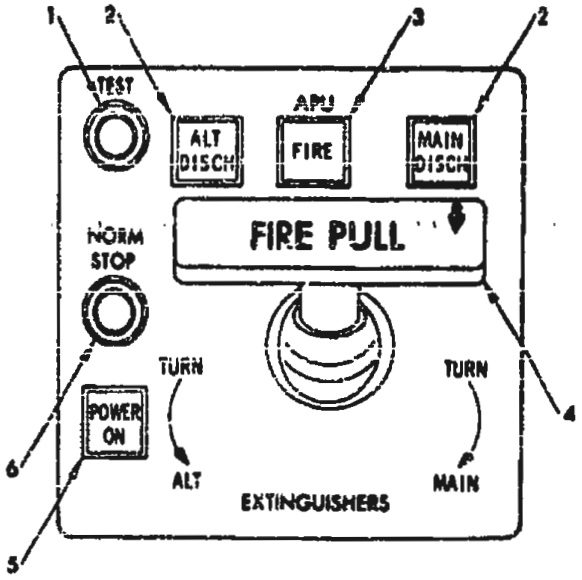
11 FAULT FLAG INDICATORS

NOTE

- THE APPEARANCE OF ONE OR MORE OF THE FOUR FAULT FLAGS WILL BE ACCOMPANIED BY AN AUTOMATIC APU SHUTDOWN. IF MORE THAN ONE FLAG APPEARS, THE FIRST FLAG TO APPEAR IS THE SHUTDOWN FAULT.
- OVERSPEED N2
  FAULT FLAG IS TRIPPED BY A FREE TURBINE SPEED HIGHER THAN 110% OR AN N/A SPEED SENSOR FAILURE.
- LOW PRESS OIL
  ABOVE 55% Ng, FAULT FLAG IS TRIPPED IF OIL PRESSURE IS LESS THAN 50 PSIG FOR A PERIOD LONGER THAN 10 SECONDS.
- HIGH TEMP OIL
  FAULT FLAG IS TRIPPED WHENEVER ENGINE OIL TEMPERATURE EXCEEDS 245°F.
- OVERTEMP TGT
  FAULT FLAG IS TRIPPED IF TURBINE GAS TEMPERATURE EXCEEDS 760°C WHEN Ng IS LESS THAN 53% AND AT 1065°C WHEN Ng IS HIGHER THAN 53%.

M1-0001-49-700

APU CONTROL Panel
Figure 1



1 TEST SWITCH

PUSHBUTTON SWITCH IS USED TO TEST ALL LAMPS ON THE PANEL EXCEPT THE POWER ON LIGHT (ITEM 5)

2 MAIN AND ALTERNATE FIRE BOTTLE DISCHARGE INDICATORS

MAIN DISCH AND ALT DISCH LEGENDS ARE ILLUMINATED WHEN RESPECTIVE APU FIRE EXTINGUISHER BOTTLE IS DISCHARGED

3 APU FIRE LIGHT

FIRE LEGEND IS ILLUMINATED WHEN FIRE DETECTION SYSTEM IS ACTIVATED. APU FIRE WARNING HORN COMES ON

4 FIRE PULL HANDLE

PULLING FIRE HANDLE DOWN:

- CLOSES APU PRIMARY AND SECONDARY FUEL EMERGENCY SHUTOFF VALVES
- SILENCES FIRE WARNING HORN
- SHUTS DOWN APU
- OPENS APU GENERATOR FIELD RELAY

ROTATING HANDLE

- DISCHARGES FIRE EXTINGUISHER BOTTLE. APU CAN BE SHUT DOWN AND MAIN FIRE BOTTLE DISCHARGED AUTOMATICALLY. IF THIS OCCURS, SYSTEM WILL RESET FOR MANUAL DISCHARGE OF ALTERNATE BOTTLE

5 POWER ON SWITCHLIGHT

"ON" LEGEND IS ILLUMINATED WHEN APU MASTER POWER SWITCH IS ON. DEPRESSING SWITCHLIGHT AFTER APU IS SHUT DOWN DEENERGIZES SOLENOID-HELD MASTER POWER SWITCH AND REMOVES BATTERY POWER FROM APU START/STOP CIRCUITS

NOTE

DO NOT DEPRESS SWITCHLIGHT UNTIL APU AIR INLET DOOR IS CLOSED

6 NORM STOP SWITCH

MOMENTARY CONTACT PUSHBUTTON SWITCH PERMITS NORMAL APU SHUTDOWN AT THE EXTERNAL CONTROL PANEL

M1-0100-49-202

APU External Control Panel - Controls and Indicators
Figure 2

HIGH TEMP OIL

OVERTEMP TGT

The reason for the automatic shutdown is displayed by the appropriate fault flag indicator located on the APU CONTROL panel (Ref. Fig. 1). Each indicator contains a magnetically operated flag, a trip coil, and a reset coil. When the trip coil is energized by the ECU, the flag appears in a window of the indicator and remains there until the reset coil is energized by depressing of the RESET button located next to the indicators.

Since a normal shutdown is triggered by a simulated Nf overspeed signal, the signal path to the OVERSPEED N2 fault flag is disabled by the deenergized APU STOP relay. This prevents the appearance of an OVERSPEED N2 fault flag during a normal shutdown.

J. POWER ON Switchlight

(1) Description

Initial latching voltage to the APU MASTER POWER switch holding coil is applied through a normally closed (momentary off) POWER ON switchlight on the APU external control panel (Ref. Fig. 2). An alternate MASTER POWER switch holding coil circuit is established through the MASTER POWER RESET relay (4911-K7) which is energized by the open air inlet door. The POWER ON legend in the switchlight provides an indication that APU master power is applied to the APU control circuits.

K. NORM STOP Button (Switch)

(1) Description

Pressing the NORM STOP button (Ref. Fig. 2) will result in a manual shutdown of the APU from the external APU control panel. The switch is electrically connected in series with the STOP button on the internal APU CONTROL panel, therefore the same shutdown sequence is initiated by both stop buttons.

3. APU Power Plant System Relays and RCCB's

A. Description

APU power plant system relays and remote control circuit breakers are listed in Table 1.

APU Power Plant System Components
Table 1

LOCATION AND COMPONENT	FUNCTION
Flight Station	
APU CONTROL PANEL (REF. FIG. 1)	Control and Indication
AUTO SHUTDOWN INDICATION RELAY (4900-K1)	Indication
Aft Electronic Equipment Area	
APU ELECTRONIC CONTROL UNIT (ECU)	APU Control
APU EQUIPMENT AND POWER CONTROL PANEL (REF. FIG. 3)	Component Interface
APU IGNITION relay (4941-K2)	APU Ignition
APU INLET DOOR NO. 2 relay (4911-K3)	Inlet and Ejector Door Position
APU INLET DOOR NO. 1 relay (4911-K4)	Inlet and Ejector Door Position
PRIMARY FIREWALL SOV relay (4961-K6)	Automatic and Normal Shutdown Control of Primary Emerg Fuel SOV
BATTERY POWER CONTROL relay (4961-K2)	Transfer of Continuous Power Source
IGV MAX SEL relay (4961-K9)	Pneumatic Load Control
IGV MODE SEL relay (4961-K8)	Pneumatic Load Control
MASTER POWER RESET relay (4911-K7)	Start/Stop Control and Remote Power Off
APU POWER CONTROL relay (4911-K1)	Power Distribution
APU START relay (4961-K12)	Start/Stop Control
APU STOP relay (4961-K1)	Start/Stop Control

APU Power Plant System Components (Cont)
Table 1.

	LOCATION AND COMPONENT	FUNCTION
R	ON AIRCRAFT 001-031 EJECTOR AND VENT VALVE relay (4911-K5)	Vent Valve Control
	ON AIRCRAFT 032-999 FIRE SHUTDOWN LATCHING RELAY	PRI and SEC EMERGENCY FUEL SOV relay
	T/R POWER INTERRUPT RELAY (4961-K15)	Continuous Power Transfer
	GEN CUTOUT relay (4961-K3)*	Continuous Power Transfer
	T/R POWER CONTROL relay (4961-K14)*	Continuous Power Transfer
	INLET FLOW SHUTDOWN RELAY (4999-K13)	Shutdown Protection
	INLET DOORS (4961-CB11)	RCCB
	ON AIRCRAFT 001-031 EJECTOR AND VENT VALVE (4911-CB4)	RCCB
	ON AIRCRAFT 032-999 EJECTOR	RCCB
	SEC FIREWALL SOV (4931-CB9)	RCCB
	PRIMARY FIREWALL SOV (4931-CB8)	RCCB
	APU IGNITION (4961-CB10)	RCCB
	APU POWER CONTROL (4961-CB11)	RCCB
	CONTROLLER POWER (4961-CB9)	RCCB
	Voltage Regulator (4961-VR1)	Circuit Protection

* Aircraft 001-014 only

Mid Electrical Service Center

	SHUTDOWN MODE relay (4961-K17)	Auto/Manual Fire Shutdown

APU Power Plant System Components (Cont)
Table 1

LOCATION AND COMPONENT	FUNCTION
NO. 1 AUTO SHUTDOWN Relay (2611-K2)	Autofire Shutdown
NO. 2 AUTO SHUTDOWN Relay (2611-K4)	Autofire Shutdown
GEN FIELD TRIP TD RELAY (2499-K15)	APU Generator and DONT LOAD Light Control
BATTERY POWER BOX	Battery Bus Power Distribution
APU STARTER RELAY (4941-K1)	Starter Power Control
APU BATTERY POWER RCCB (2436-CB3)	RCCB
APU POWER TRANSFER RELAY (2436-K1)	Power Transfer
225 AMPS CURRENT LIMITER (4941-F1)	Starter Current Limiter
Fuselage Underside	
External APU Control Panel (Ref. Fig. 2)	APU Shutdown Function
APU Compartment	
APU Engine Starter	Engine Start
Ignition Exciter	Engine Ignition
Fuel Shutoff Valve	Start/Stop Control
Fuel Bypass Valve	Start/Stop Control
APU Engine Inlet Door and Vent Ejector Door	APU Engine Air Supply and Compartment Ventilation
IGV Load Compressor Controller (Torque Motor)	Pneumatic Load Control
IGV Feedback Transducer	Pneumatic Load Control

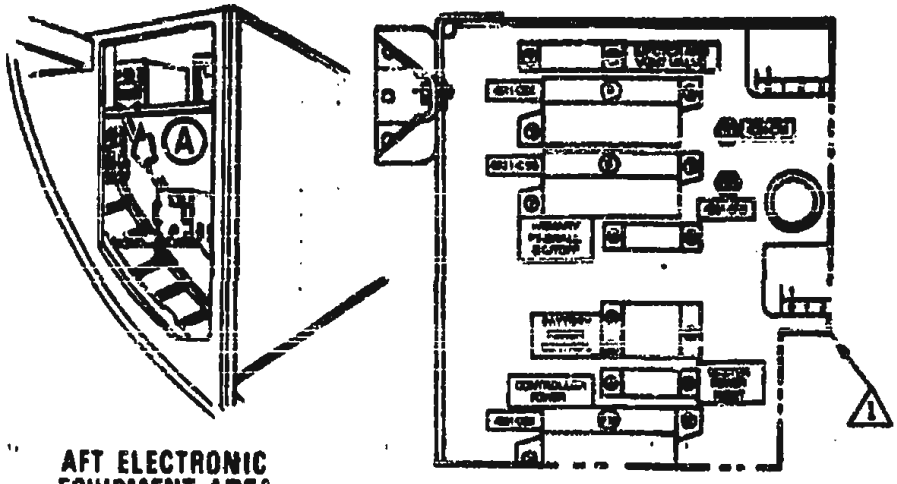
APU Power Plant System Components (Cont)
Table 1

LOCATION AND COMPONENT	FUNCTION
Free Turbine Speed Controller (Fuel Torque Motor)	Speed Control
Engine Temperature Sensing Harness	Engine Turbine Temperature
Gas Generator (Ng) Tachometer	Speed Control
Free Turbine Speed (NfA) Sensor	Speed Control
Free Turbine Speed (NfB) Sensor	Speed Control
Inlet Temperature (Tt2) Sensor	Speed and Load Control
Current Transformer	Load Transient Signal
Low Oil Pressure Switch	Shutdown Protection
High Oil Temperature Switch	Shutdown Protection
Clogged Fuel Filter Switch (Not applicable to aircraft with APU P/N 738089-20 thru -99 and earlier units with HS SB49-105)	Control Panel Indication
Float Switch (Low Oil Quantity)	Control Panel Indication
Elapsed Time Indicator	Engine Operating Time
Differential Pressure Switch	Shutdown Protection
APU Emergency Fuel Shutoff Valves	Start/Stop Control
APU Bleed Air S/O Valve	Pneumatic Supply

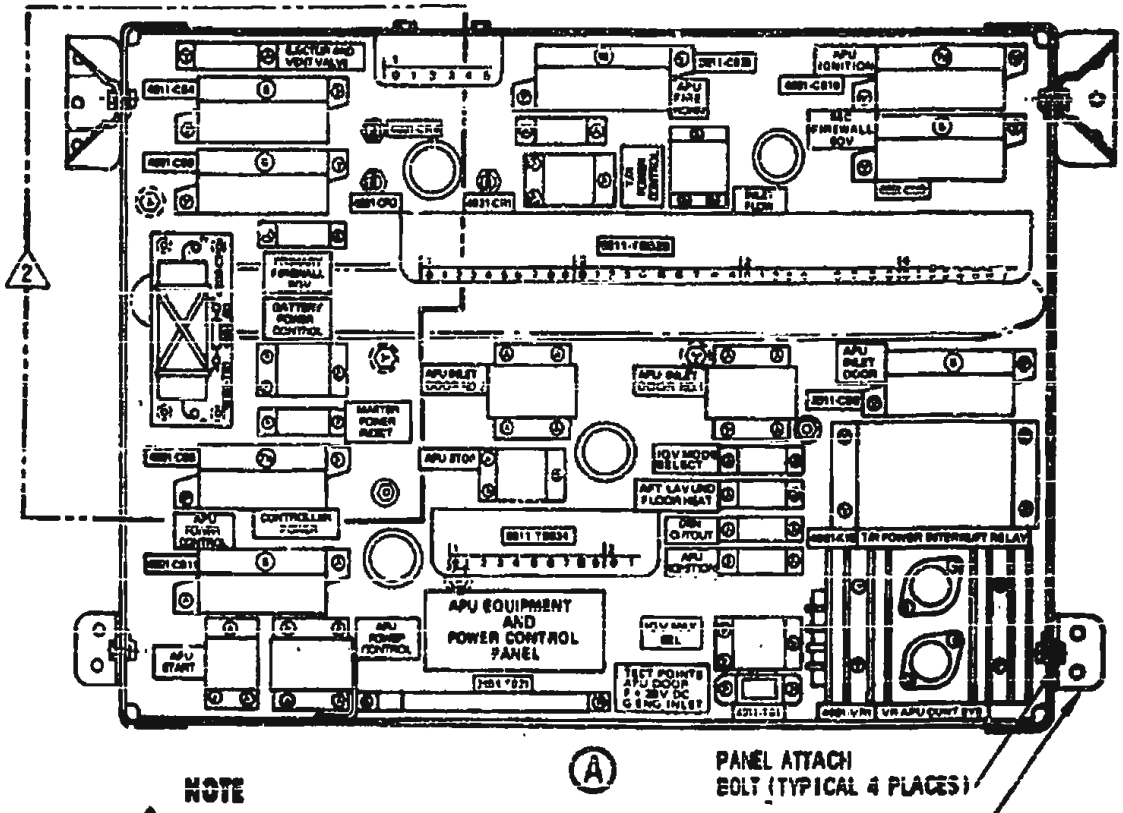
4. APU Electronic Control Unit (ECU)

A. Description

The APU Electronic Control Unit (Ref. Fig. 4) is mounted on a rack in the aft electronic service center and is cooled by natural convection and conduction. The ECU contains three printed circuit boards interconnected by a mother board. The unit is connected to aircraft wiring through two



AFT ELECTRONIC
EQUIPMENT AREA
ZONE 164



PANEL ATTACH
BOLT (TYPICAL 4 PLACES)

PANEL SUPPORT
BRACKET (TYPICAL 4 PLACES)

NOTE

1 WITHOUT SB 49-038

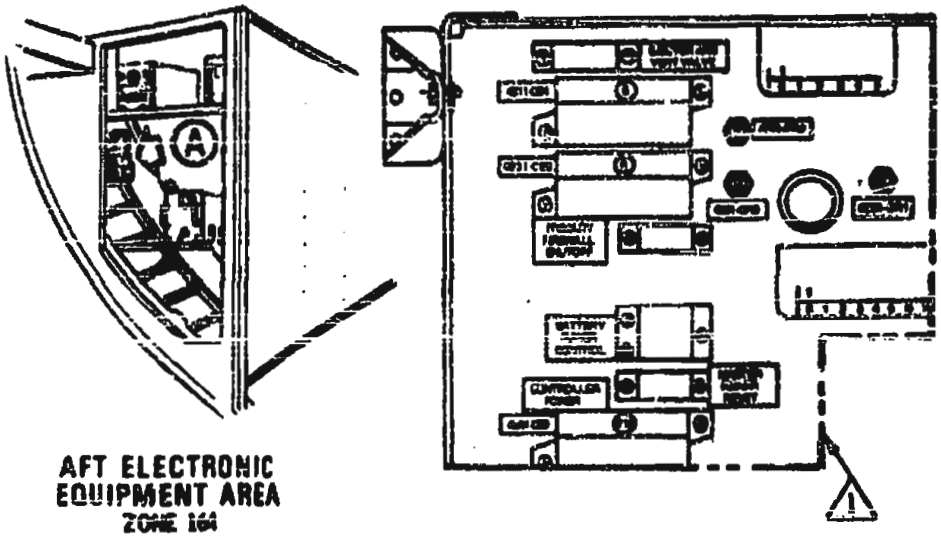
2 WITH SB 49-038

3 PANEL WIRING NOT SHOWN

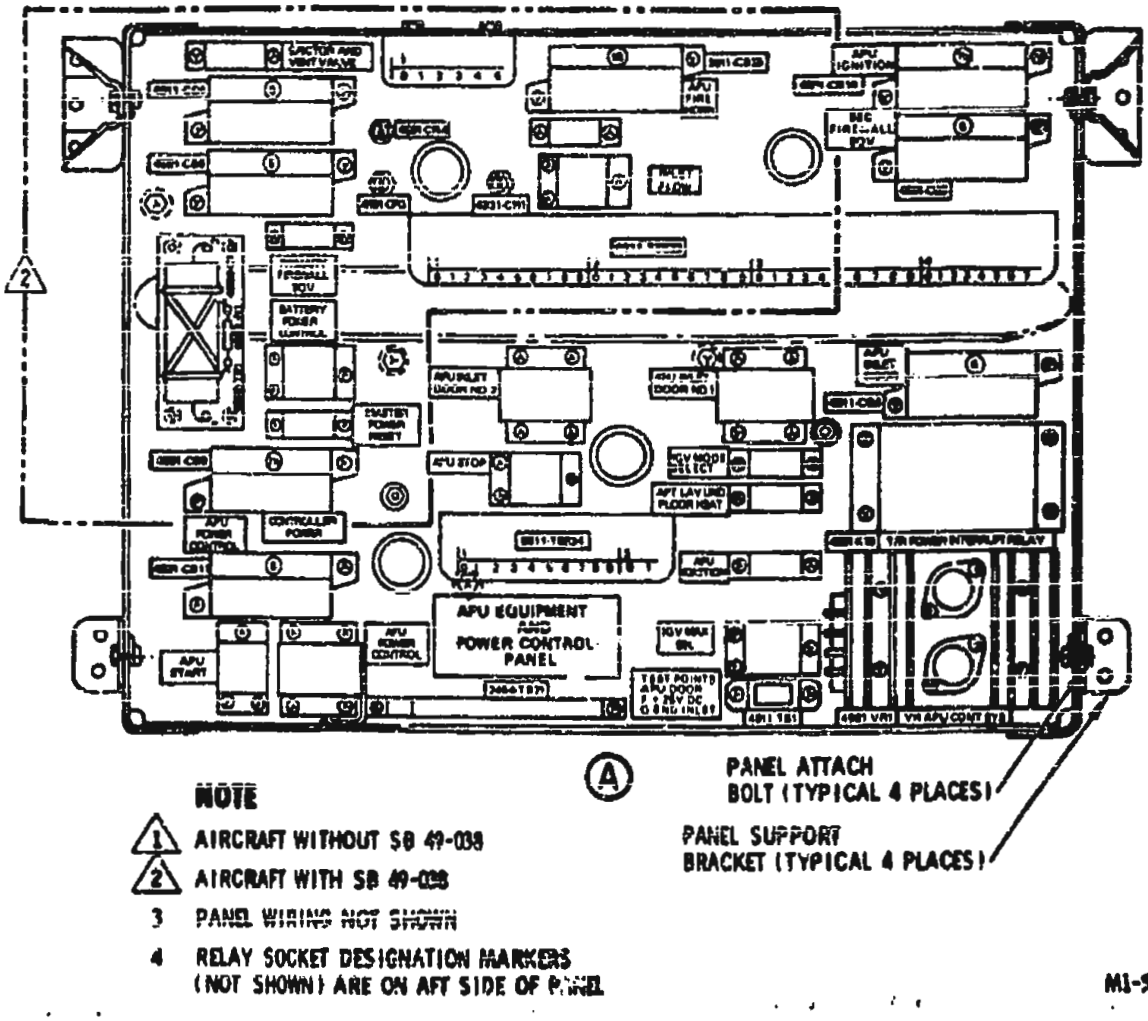
4 RELAY SOCKET DESIGNATION MARKERS (NOT SHOWN) ARE ON AFT SIDE OF PANEL

M1-3500-49-491

APU Equipment and Power Control Panel
Figure 3



AFT ELECTRONIC EQUIPMENT AREA
ZONE 164

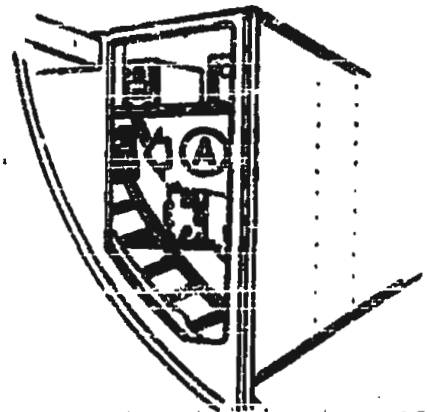


NOTE

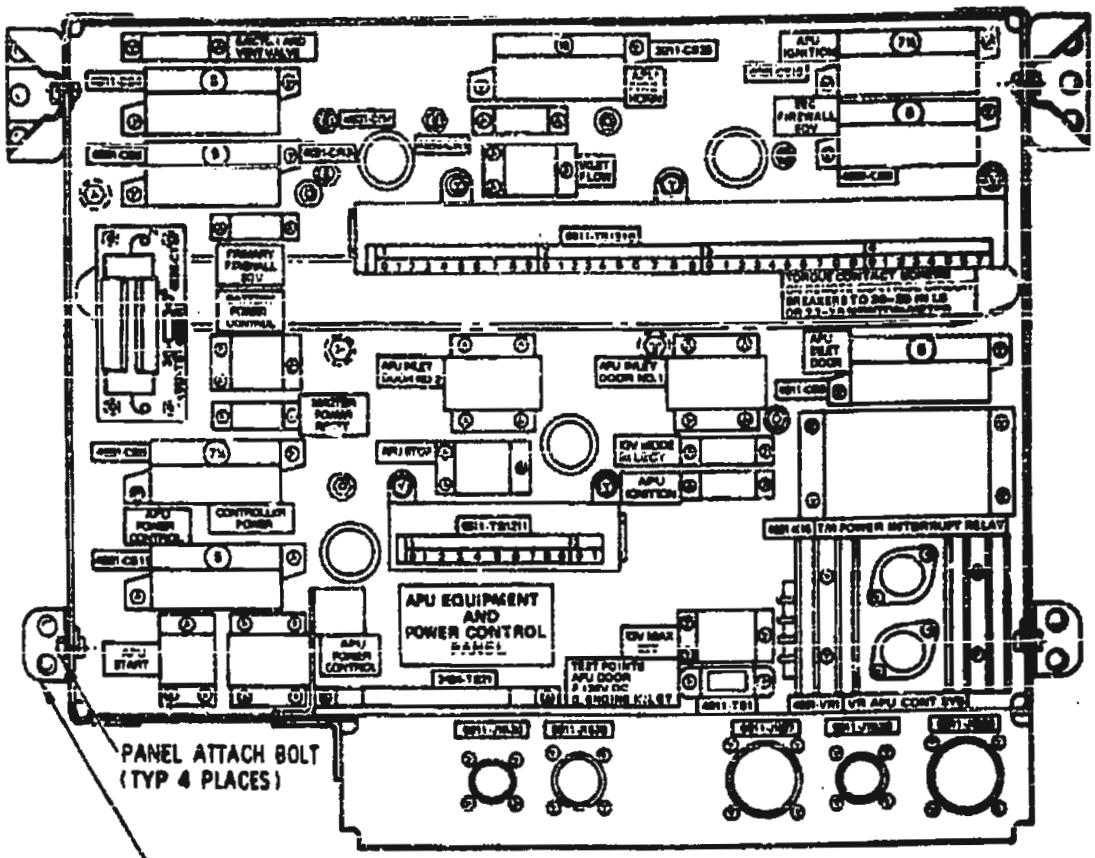
1. AIRCRAFT WITHOUT SB 49-039
2. AIRCRAFT WITH SB 49-039
3. PANEL WIRING NOT SHOWN
4. RELAY SOCKET DESIGNATION MARKERS (NOT SHOWN) ARE ON AFT SIDE OF PANEL

M1-5500-49-499

APU Equipment and Power Control Panel
Figure 3



AFT ELECTRONIC EQUIPMENT AREA
ZONE 164



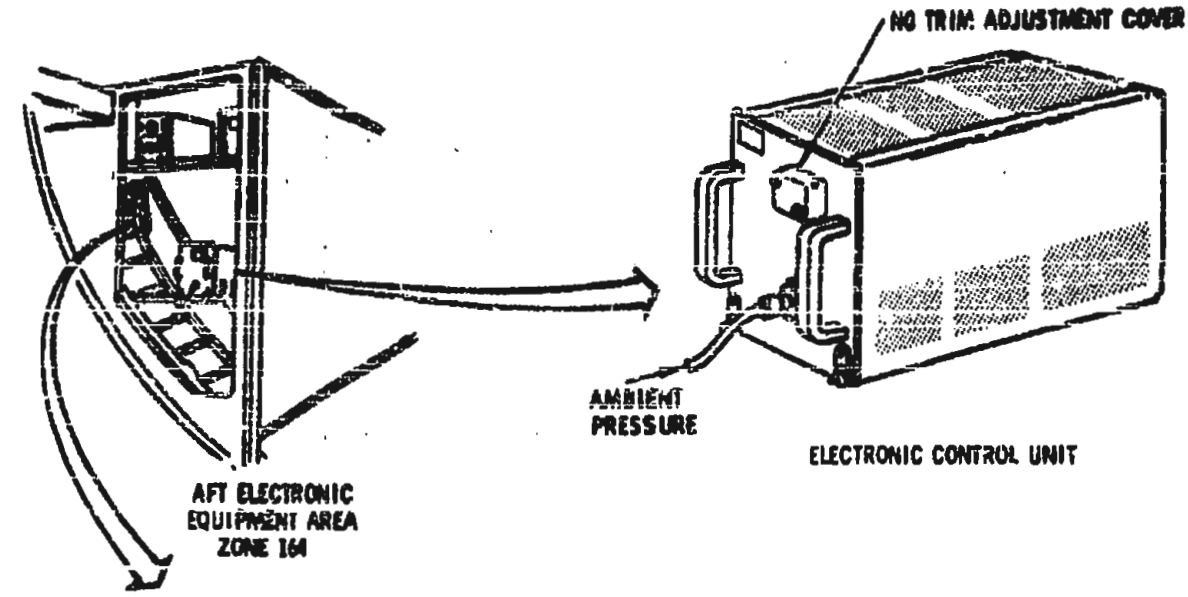
NOTE

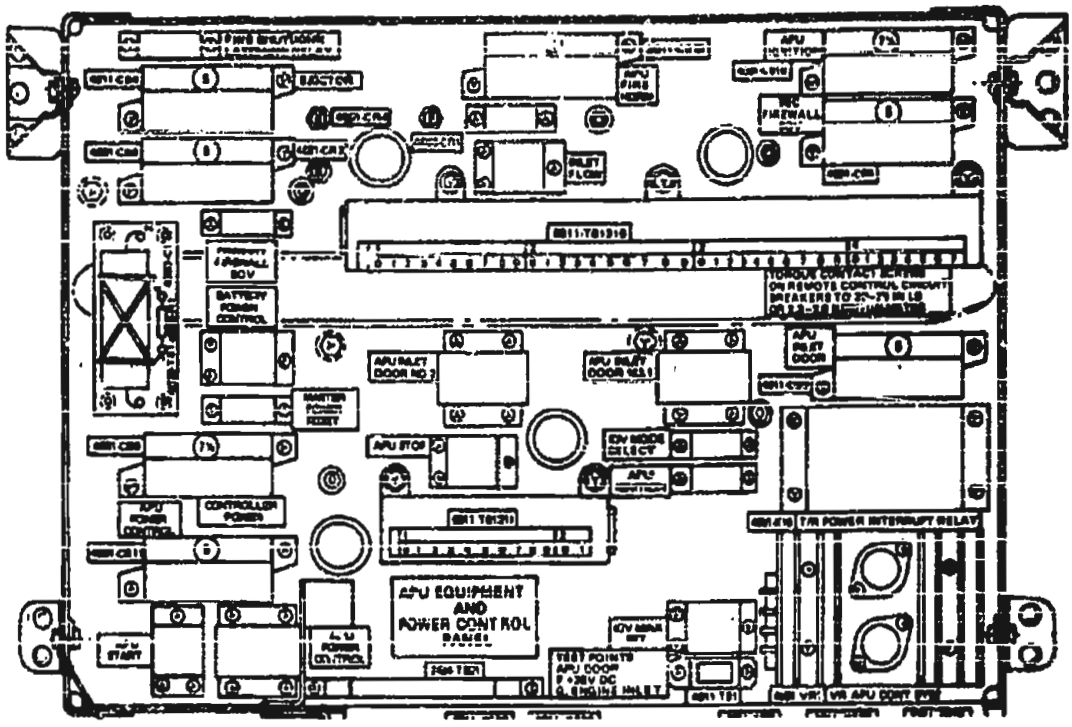
1 PANEL WIRING NOT SHOWN

2 RELAY SOCKET DESIGNATION MARKERS ARE AFFIXED TO AFT SIDE OF PANEL

M1-0000-49-484

APU Equipment and Power Control Panel
Figure 3





APU Equipment and Power Control Panel
Figure 3

connectors on the rear of the case. A pneumatic connection for ambient air pressure is provided on the front of the case. An Ng limit adjustment (trim speed) potentiometer is located on the front panel under a protective cover.

CR TWA Modification Order 94170 has been accomplished to CR install 3 amp fuses and indicator lights on the front panel CR of the APU electronic controller. The fuses protect the CR controller, internal circuits and components, from excessive CR external power loads from aircraft wiring and APU engine CR components that interface with the controller.

CR During normal operation, the fuse indicator lights will not CR be illuminated. If either fuse blows, indicating probable CR system malfunction, the respective indicator light will CR illuminate. The upper fuse provides ECU protection from the CR APU fuel shut-off/bypass valve, aircraft ignition relay CR (4941-K2), and APU starter relay (4941-K1). The lower fuse CR provides ECU protection from the inlet flow relay CR (4999-K13), the inlet guide vane torque motor, and the free CR turbine speed controller torque motor. Fuses, P/N AGC3 (TWA CR Stk Nbr 41-0910) used.

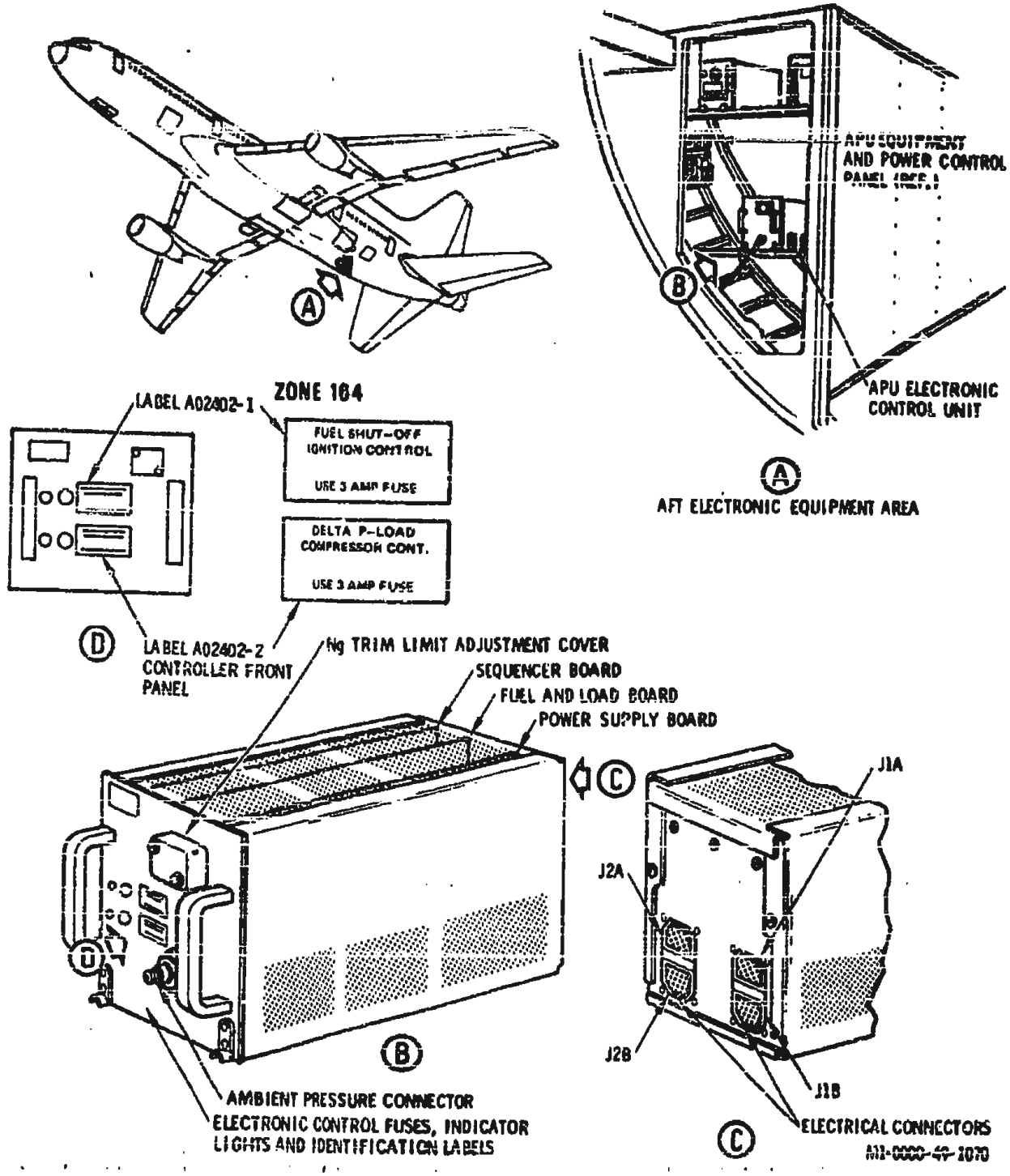
Two fundamental subsystems are incorporated within the ECU. One subsystem consists of a sequencer which controls starting, stopping and emergency shutdown protection of the APU. The other consists of the modulating controls which include a speed control system, a load control, and a transient control, all of which interact simultaneously to protect and maintain proper control of the APU engine gas generator and free turbine speed. Signal input and outputs applicable to the ECU are listed in Tables 2 and 3.

Signal Inputs to APU Electronic Control Unit
Table 2

SIGNAL	CONNECTOR PINS	LEVEL/TYPE
NfA Sensor	J1B-26 to J1B-31	4V ac Peak to Peak (Sine Wave) of Variable Frequency
NfB Sensor	J1B-40 to J1B-41	4V ac Peak to Peak (Sine Wave) of Variable Frequency
Ng Sensor	J1B-37 to J1B-32	10V ac Min. (Sine Wave) of Variable Frequency (4.3K ohms input resistance)

Signal Inputs to APU Electronic Control Unit (Cont)
Table 2

SIGNAL	CONNECTOR PINS	LEVEL/TYPE
Tt2 Sensor	J1B-28 to J1B-27	0 to 20K ohms/Thermistor
Pamb Sensor	Front of Chassis	Ambient Air Pressure
Current Transformer	J1B-16 to J1B-17	0 to 0.265 amps/ac (400 Hz)
TGT	J2A-1 (CR) to J2A-7 (AL)	0 to 50 MV dc
IGV Position Feedback	J1B-10 to J1B-12 and J1B-13	0 to 8.0V dc
	J1B-20 to J1B-12 and J1B-13	+15V dc Fixed Bias
Max Mode Select	J1A-14 to J1A-43	Open or Closed Relay (0V dc)
Norm Mode Select	J1A-23 to J1A-43	Open or Closed Relay (0V dc)
Min Mode Select	J1A-24 to J1A-43	Open or Closed Relay (0V dc)
Start Command	J1A-5 to J1A-18	Open or Closed Relay (0V dc)
Stop Command	J1A-8 to J1A-18	Open or Closed Relay (0V dc)
High Oil Temperature (HOT)	J1B-44 to J1B-45	Open or Closed Switch (0V dc)
Low Oil Pressure (LOP)	J1B-34 to J1B-35	Open or Closed Switch (0V dc)
Door Malfunction	J1B-18 to J1B-39	Open or Closed Switch (28V dc)
Ng Limit Adjust	Access Cover	10 Turn Pot/Full CW is Min.



CR
CR

APU Electronic Control Unit
Figure 4

EFFECTIVITY: ALL

001B

Signal Outputs from APU Electronic Control Unit
Table 3

SIGNAL	CONNECTOR PINS	LEVEL/TYPE
Control Signal to Torque Motor in Load Compressor Controller	J1B-19 to J1B-29	0 to 150 milliamps (at +28V dc)
Control Signal to Free Turbine Speed Controller (Nf Torque Motor)	J1B-21 to J1B-30	0 to 250 milliamps (at +28V dc)
Ignition Control	J1A-4 to J2A-5	0 or +28V dc/Relay Contacts to Relay Coil
Starter Control	J1A-37 to J2A-5	0 or +28V dc/Relay Contacts to Relay Coil
Fuel Bypass Control	J1B-25 to J2A-5	0 or +28V dc/Relay Contacts to Solenoid Coil
Fuel Shutoff Control	J1B-38 to J2A-5	0 or +28V dc/Relay Contacts to Solenoid Coil
DON'T LOAD Signal	J1A-2 to J2A-5	0 or +28V dc to Generator Time Delay
R Generator "On speed" (Load) Signal	J1A-9 to J1A-28	Open or Closed Relay Contacts (0V dc)
Ng Indicator	J1A-45 to J1A-44	0 to +5 Volt Variable Frequency Square Wave
TGT Indicator	J1A-20 to J1A-30	0 to 1.00 milliamps
Nf Overspeed Fault	J1A-38 to J1A-40	+28 or 0V dc/Diode Gate to Flag Coil
Low Oil Pressure (LOP) Fault	J1A-10 to J1A-40	+28 or 0V dc/Diode Gate to Flag Coil
High Oil Temp (HOT) Fault	J1A-39 to J1A-40	+28 or 0V dc/Diode Gate to Flag Coil

Signal Outputs from APU Electronic Control Unit (Cont)
Table 3

SIGNAL	CONNECTOR PINS	LEVEL/TYPE
High Turbine Temp (TGT) Fault	J1A-16 to J1A-40	+28 or 0V dc/Diode Gate to Flag Coil

5. APU Control

A. General

The basic function of the APU gas turbine engine is to develop and maintain the power required to drive a load hardware gearbox which, in turn, uses this power to drive an air compressor, an electrical generator, and a cooling air fan. It does this by serving solely as a gas generator; engine power output is entirely reflected in the energy of the gas generator exhaust gases. Power is extracted from the engine by a free turbine that is driven by the exhaust gases and is coupled by a power output shaft to the load hardware gearbox. The amount of power that the free turbine must transmit to the load hardware gearbox is directly related to the loads applied to the electrical generator and air compressor. These demands are reflected as signals from the ECU to the free turbine speed controller. The free turbine speed controller satifies these demands by controlling the amount of fuel that the fuel control unit meters to the engine. The power used in driving the cooling air fan is relatively low and constant and is not reflected in any varying demands on the engine control system.

The electrical generator, being directly driven by the load hardware gearbox, must be driven at a constant speed in order to maintain its output frequency at 400(±5)Hz. This imposes a design requirement that the free turbine speed be maintained at a constant 33,000 rpm. All demands on the engine are therefore related to establishing a power output that maintains the free turbine at 33,000 rpm. These demands are based on a sharing of the available power required to satisfy loads placed on the air compressor and the generator by the aircraft electrical system. Under conditions demanding maximum engine power output, the APU control system will partially unload the air compressor and give the electrical generator priority over engine power. This, once again, is necessary because of the design requirement that the generator output be maintained at 400(±5)Hz. These functions are automatically controlled by the ECU through two control loops; one regulates gas generator (Ng) rpm and the other modulates compressor inlet

guide vane (IGV) position. Under conditions not requiring maximum engine power, the ECU schedules fuel flow to the gas generator as a function of an integrated free turbine speed error signal and an IGV position signal. As the engine approaches its maximum power level, fuel is automatically limited to schedule power output as a function of gas generator speed, TGT, and engine compressor inlet air temperature. Under these conditions, the ECU will start to close the load compressor inlet guide vanes as necessary to maintain the power required by the generator drive adapter for keeping the generator at its operating frequency. The compressor inlet guide vanes are modulated in the same manner whenever the APU is subjected to sudden transient electrical loads.

B. Load Control

(1) Description and Operation

A mode selector switch on the APU CONTROL panel is used to select three modes of operation: MIN MODE, NORM, and MAX MODE. The mode of operation selected is primarily determined by the mass air flow required to satisfy the air load demand.

Since the speed of the load compressor is constant, the amount of air it must supply to satisfy the air load demand is met by controlling the amount of air admitted to the compressor inlet. This is done by means of an inlet guide vane assembly (IGV) incorporating a set of variable guide vanes. An inlet guide vane feedback transducer, load compressor controller, a pneumatically operated piston type guide vane actuator [operated by engine compressor (P3) air pressure] and the ECU comprise a servo control loop which controls IGV position. The ECU, in response to the mode select command, transmits air demand signals to the load compressor controller which, in turn, modulates the amount of P3 air supplied to the IGV actuator. The actuator mechanically positions the inlet guide vanes in the direction required to unload or load the compressor. The IGV position transducer continually monitors IGV position and supplies the ECU with the feedback signals required to balance the servo loop for the selected IGV position.

In exercising control of IGV position, the ECU processes internal inputs from the gas generator/free turbine (Ng-Nf) speed control path, ECU schedule control path, and transient control paths. The larger of the latter two inputs is summed with the Ng-Nf input and the feedback signal from the IGV position

transducer to provide a error signal that reflects the percentage of IGV actuator stroke required for repositioning the IGV's. This signal is amplified and applied to the load compressor controller which directs the IGV actuator to reposition the IGV's.

C. Free Turbine Speed Control

(1) Description and Operation

One of the primary functions of the ECU is to maintain free turbine speed (Nf) at a constant 33,000 rpm. This is vitally necessary because the APU generator is directly driven by the free turbine and must be operated at speed which will not allow its output frequency to deviate more than ±5 percent. It must do this under varying ambient pressures and temperatures, and rapid changes in electrical and pneumatic load requirements.

To maintain the accurate steady state requirements of the free turbine, the ECU uses a gas generator (APU engine) power modulating control loop in which a variation in fuel flow produces a corresponding change in engine power output. The actual free turbine speed is sensed by the NfA speed sensor and applied as a continuous feedback signal to the ECU where it is compared to an internal 33,000 rpm reference. The ECU reacts to an error in the NfA input signal by calculating a gas generator power reference change requirement (delta NgR). NgR is summed with a gas generator speed reference (Ng set ref.) and compared with the actual gas generator speed applied to the ECU by the Ng tachometer. The resulting integrated gas generator power change signal is applied to the free turbine speed controller (fuel control torque motor) which increases or decreases fuel flow as required to reduce the delta NgR error to zero. Actual gas generator speed change (and power to the free turbine) is proportional to the change in fuel flow to the engine. The free turbine is thus maintained at 33,000 rpm by changing fuel flow to control engine speed and power applied to the free turbine.

D. Transient Control

(1) Description and Operation

The most direct effect upon APU operation and the authority that the ECU must command in maintaining free turbine speed occurs when there are transients or sudden changes in electrical loads applied to the APU

generator. An increase in electrical load is sensed by an electrical load sensor (current transformer) and is reflected in an immediate demand for an increase in engine power. The ECU must respond by providing for an immediate increase in fuel flow. It must also compensate for any lag in the ability of the engine to accelerate to the higher power level required to sustain free turbine speed. The acceleration rate of a gas turbine engine is a direct function of engine air inlet pressures. At standard sea level conditions, engine response is fairly rapid. However, as altitude is increased, engine response is increasingly slower and there is a greater lag between an increase in fuel flow and its effect in producing an increase in engine power. A transient power control system is therefore incorporated in the ECU. Its primary function is to compensate for this inherent lag in engine acceleration. It does this by momentarily driving the IGV's in the close direction to unload the compressor. The momentary reduction in power required to drive the compressor allows the engine to respond more rapidly to the higher power level required by the increased load.

To maintain compressor loading at higher altitudes, the IGV's are progressively driven open and IGV scheduling is directed by the ECU as a function of ambient air pressure and temperature. Under these conditions, the compressor load changes required to maintain Nf speed with transient electrical loads can require rather large excursions in IGV position. The IGV actuator is therefore designed to slew full stroke in a minimum time of 5 seconds.

As increasing electrical and pneumatic system loads are applied to the APU, a point is eventually reached where the engine speed/power output relationship cannot be increased without exceeding the maximum allowable engine speed and gas turbine temperature (TGT) limits. At this time, the authority the ECU commands in scheduling engine fuel flow (and power) is limited by the setting of the Ng trim limiting potentiometer. The APU is then in an operating regime called load topping. Since the ECU can no longer command an increase in engine power, other means must be taken to maintain Nf speed at 100 percent rpm. The ECU does this by closing the IGV's sufficiently to reduce the compressor load and maintain Nf speed. Closing the inlet guide vanes will produce a corresponding decrease in bleed air duct pressure.

E. Load Topping Control

(1) Description and Operation

The load topping control system comes into operation whenever the combined pneumatic and electrical loads are causing the free turbine to absorb all the power available from the gas generator and still more power is demanded from the APU generator. Under these conditions the ECU biases the IGV's in the close direction and priority over the available power is given to the generator drive adapter. This maintains the free turbine at rated speed even though the gas generator has topped out at its maximum speed limit.

At very low inlet temperatures, choking of the compressor inlet is the limiting power criteria. At intermediate inlet temperatures, maximum gas generator speed conditions are the limiting criteria. As inlet temperature increases further, maximum turbine temperature becomes the limiting condition. The limiting gas generator speed schedules are incorporated within the ECU and are varied with inlet temperature or TGT, as applicable, to meet these criteria. At inlet temperatures from 103 degrees F to near 0 degrees F, the limiting speed is constant and is set at the APU engine data plate value (gas generator speed for rated power on a 103 degrees F day) by a trim adjustment on the ECU. At inlet temperatures above 103 degrees F and below 0 degrees F, the limit schedule is reduced. Provisions are incorporated into the limiting schedule to manually trim the schedule to account for engine-to-engine variation and deterioration in performance during engine life.

Under such conditions, TGT on aircraft with a P/N ED724438-10 ECU, is prevented from exceeding 1050 degrees C when operating in the load topping regime by a TGT limiter in the ECU. The ECU accomplishes this by commanding a reduction in the inlet guide vane open position to lessen the operating load on the engine. The limiter thus acts to minimize the damaging effects on engine hot section life resulting from operating under heavy loads at high TGT temperatures. A normally operating clean APU will exhibit no effect of limiter operation. However, as operating temperatures tend to increase due to engine contamination, the reduction in inlet guide vane opening will be evident as a loss in duct pressure. Approximately 1 psi loss in duct pressure for each 11 degrees C that TGT tends to rise above the 1050 degrees C limit can be expected. This TGT limiting schedule does not affect nor is it influenced by the Ng trim adjustment which biases the normal Ng limiting schedule.

F. Automatic Shutdown Circuits

(1) General

To protect the APU engine from potentially harmful operating conditions, the APU automatic control circuitry is designed to shut down the unit if any one of the events listed below occurs.

CAUSE OF SHUTDOWN	SHUTDOWN INDICATION
Free Turbine Overspeed	OVERSPEED N2 Flag
Low Oil Pressure	LOW PRESS OIL Flag
High Oil Temperature	HIGH TEMP OIL Flag
R High Turbine Temperature	OVERTEMP TGT Flag
Loss or Interruption of Electrical Power to ECU	As above
Loss of Ng Tachometer Signal to ECU	As above
Autofire Shutdown Circuit is Activated	No Flags. Fire Warning and Fire Horn (On Ground Indications)
Foreign object blockage of load compressor air inlet duct	INLET FLOW light on

(2) Free Turbine Overspeed

Free turbine speed (Nf) is sensed by the NfA and NfB speed sensors. The ECU normally looks at the NfA input signal for the free turbine speed signal used in the APU speed/load control circuitry and to the NfB input signal for controlling the generator and detection of free turbine (N2) overspeed. The ECU, however, responds to Nf overspeed signals from both sensors. It will normally shut down the APU when the NfB sensor detects an N2 speed of 110 percent. If the NfB sensor fails, the ECU will shut down the APU when the NfA sensor detects 110 or 112 percent N2 speed (depending on controller).

During an APU start, the ECU will shut down the APU if the NfA sensor input signal is not present at 55 percent Ng. A loss of the NfB sensor input will prevent the generator from coming on the line and the DONT LOAD light from going out. If the NfB signal is

not present when free turbine speed reaches 95 percent Nf, the ECU start sequencing circuit cannot switch from the 98 percent Nf reference signal used during the start sequence to the actual N2 speed signal supplied by the NfA sensor. The resulting demand for increased fuel flow will cause the APU to accelerate into an N2 overspeed condition and be shut down by an NfA sensor overspeed signal to the ECU.

(3) Low Oil Pressure

The ECU monitors APU engine oil pressure by means of a pressure-actuated low oil pressure switch. Normal engine oil pressure at engine speeds higher than 2700 rpm is 80 to 100 psig. The switch is opened whenever pressure falls below 50 psig. If the condition persists for more than 10 seconds, the ECU will shut down the APU and trip the LOW PRESS OIL fault flag. During an APU start the low oil pressure fault circuit is inhibited until 55 percent Ng is attained.

(4) High Oil Temperature

APU engine oil temperature is monitored by a high oil temperature sensing switch on the engine accessory case. The switch is connected to the fault control relay in the ECU. Should engine oil temperature exceed 245(±5) degrees F, the ECU will shut down the APU and trip the HIGH TEMP OIL fault flag on the APU CONTROL panel.

(5) High Turbine Temperature

APU engine operating temperatures sensed by thermocouples at various locations in the unit are summed in an engine temperature sensing harness and applied as a turbine gas temperature (TGT) signal to the ECU. During an engine start, the ECU limits this
R temperature to 760 degrees C when Ng is less than 55 percent and 1065 degrees C when Ng is greater than 55 percent. If TGT rises above these limits the ECU will shut down the APU and trip the OVERTEMP TGT flag. (However, refer to the effect of TGT limiter operation described under load topping control.)Any one of the four conditions listed above will command the ECU to trip the appropriate fault flag and initiate an APU fault shutdown.

(6) Loss of Electrical Power to the ECU.

If electrical power to the ECU is lost (even momentarily) the ECU will command an immediate APU

shutdown by removing the energizing voltage to the automatic fuel shutoff valve solenoids (fuel bypass valve opens; fuel shutoff valve closes).

(7) Loss of Ng Tachometer Signal to ECU

If the gas generator (Ng) tachometer signal to the ECU is interrupted or lost, the ECU will command an immediate APU shutdown by removing the energizing voltage to the fuel solenoids (fuel bypass valve opens; fuel shutoff valve closes). In this case, no fault flag will be energized. A restart will be inhibited because an Ng signal input to the ECU is required before the ECU will initiate fuel flow and ignition.

(8) Autofire Shutdown Circuit Activated

The APU is automatically shut down whenever the APU fire detection system (Ref. 26-00-00) initiates operation of the automatic fire shutdown circuitry. When airborne, the autofire shutdown function is active only when the AUTOFIRE SHUTDOWN switchlight on the APU CONTROL panel is in the armed position (ARMED light is on). When on the ground, the autofire shutdown circuit is always armed, regardless of switchlight position. (Refer to AUTOFIRE SHUTDOWN CIRCUIT OPERATION and Section 26-00-00.)

G. Fail-Safe Provisions

(1) General

The essential complexity of the APU and electronic control system requires as many attendant fail-safe provisions as is feasible. In addition to the automatic shutdown protection features previously described, the following are employed:

(a) Fuel Shutoff Valve

The fuel shutoff valve is a normally closed solenoid valve. Being energized open, a loss of power or coil failure will close the valve and shut off fuel flow to the engine (Ref. 49-31-00).

(b) Fuel Bypass Valve

The fuel bypass valve is a normally open solenoid valve. Being energized closed, a loss of power or coil failure will open the valve and bypass fuel back to the fuel pump. This causes a drop in fuel pressure to the minimum pressure valve which

closes and shuts off fuel flow to the engine (Ref. 49-31-00).

(c) Free Turbine Speed Controller

A loss of electrical signal or torque motor failure will cause the free turbine speed controller to reduce the engine fuel control output to minimum fuel flow and drive the APU to idle speed (Ref. 49-31-00).

(d) IGV Load Compressor Controller

A loss of signal to the controller, or torque motor failure, will drive the inlet guide vanes to the full open position. With the inlet guide vanes full open, compressor loading is increased and the possibility of a free turbine overspeed is reduced.

(e) Gas Generator Tachometer

If the gas generator (Ng) tachometer signal to the ECU is interrupted or lost, the ECU will command an immediate APU shutdown by removing the energizing voltages to the fuel control solenoids (fuel bypass valve opens; fuel shutoff valve closes). There will be no fault flag indication. There is no air inlet door close signal and the air inlet door will remain open. Without an Ng signal input to the ECU, a restart will be inhibited.

(f) Free Turbine Speed Sensors

NfA (Bottom Sensor)

A failure of the NfA speed sensor or loss of the NfA signal to the ECU will result in an APU shutdown with the OVERSPEED N2 fault flag tripped. Since the OVERSPEED N2 fault flag is tripped by either an actual Nf overspeed or loss of the NfA signal, the fault can be isolated by a restart attempt. If the shutdown was due to a loss of NfA signal, the APU will shut down when engine speed rises higher than 55 percent Ng.

NfB (Top Sensor)

A failure resulting in loss of the NfB speed sensor signal does not disable the overspeed protection shutdown feature since the NfA speed

sensor which also senses Nf (free turbine) speed will independently actuate the Nf overspeed shutdown circuit. However, loss of NfB sensing will cause the ECU to keep the DONT LOAD light on and the APU generator off the line. During a start with the NfB sensor inoperative, Ng and free turbine speed will increase until the secondary NfA overspeed protection shutdown circuit is actuated since the ECU sequencing circuit is inhibited from switching from the false internally generated Nf reference speed signal to the actual NfA speed signal. This will drive the APU into an Nf overspeed condition and an NfA triggered shutdown.

(g) Inlet Flow Differential Pressure Switch

APU load compressor damage resulting from surging induced by foreign object blockage of compressor air inlet flow is prevented by an APU compartment-to-load compressor air inlet duct differential pressure switch. The switch is actuated whenever APU compartment to air inlet duct differential pressure increases to approximately 4.6 psid and results in an APU control circuitry triggered shutdown of the APU. To avoid a possible loss of pneumatic pressure when using APU air during an engine start, this function is disabled when MAX MODE operation is selected.

H. APU Electrical Power Control

(1) General

Application of electrical power to the APU circuits is controlled by the APU MASTER POWER switch on the APU CONTROL panel (Ref. Fig. 5). With the switch in the OFF position, aircraft power is disconnected from all the APU control circuits except the close circuit for the APU primary emergency fuel shutoff valve. This valve receives its close power voltage from DC BUS 2 and DC GND SVCE BUS buses (Ref. Fig. 6) through relaxed contacts of PRIMARY FIREWALL SOV RELAY (4961-K6). With APU master power off and the dc ground service busses powered from sources other than the APU generator, the valve, if open, will be driven closed. This assures that the fuel supply to a non-operating APU is shutoff. It should be noted that if the APU was the only source of dc bus power the last time it was operated, the valve will be left open when dc bus power is lost at APU shutdown. If external aircraft power is not

applied prior to another APU start, there will be no EMERGENCY SHUTOFF PRI light indication of valve opening during the start sequence.

Initial application of electrical power to the APU circuits and operation of the APU starter requires aircraft BAT BUS power. When the APU MASTER POWER switch is placed in the ON position, 28V dc power is applied to the APU continuous power distribution terminal modules, and through the MASTER POWER switch, to the APU control circuits as APU master power.

When the APU has accelerated to operating speed and the APU generator is on the line, the continuous power and master power distribution circuits are transferred to the dc ground service busses which are energized by the APU generator. If the start is initiated with the dc ground service busses already energized, the power transfer will occur during the start sequence as described under the following Paragraph H(2). An extremely rapid response solid state T/R power interrupt relay maintains continuous power to the ECU and APU control circuits during the interval that power is being transferred between the BAT BUS and dc ground service busses.

(2) Continuous Power Transfer (Aircraft 001-014)

Transfer of the continuous power distribution circuits from BAT BUS to DC GND SVCE BUS (T/R) power occurs as follows:

NOTE: T/R POWER INTERRUPT RELAY (4961-K15) operates in conjunction with GEN CUTOUT relay (4961-K3), T/R POWER CONTROL relay (4961-K14), and BATTERY POWER CONTROL relay (4961-K2) to select the source of continuous power (Ref. Figure 5).

(a) When the APU MASTER POWER switch is placed to the ON position, APU BATTERY POWER RCCB (4961-CB11), and CONTROLLER POWER RCCB (4961-CB9) are closed and BAT BUS voltage is applied through voltage regulator (4961-VR1) and the relaxed contacts of BATTERY POWER CONTROL relay (4961-K2) to the continuous power distribution terminal modules. BAT BUS voltage routed through CONTROLLER POWER RCCB (4961-CB9) and relaxed BATTERY POWER CONTROL relay (4961-K2) is made available at APU POWER CONTROL relay (4911-K1). A parallel path for battery power to the 4911-K1 relay is made through T/R POWER INTERRUPT relay (4961-K15). If the T/R POWER CONTROL relay is in the latched (T/R mode)

position when master power is applied, 28V dc from the APU POWER CONTROL relay routed through the relaxed APU INLET DOOR NO. 2 (4911-K4) and BATTERY POWER CONTROL (4961-K2) relays will energize the T/R POWER CONTROL relay reset coil and unlatch the relay. Normally, the reset coil is energized by the ECU during a normal APU shutdown when the continuous power source is transferred to the BAT BUS.

(b) During an APU start, the ECU is powered by 28V dc power applied through parallel paths made in the BATTERY POWER CONTROL relay and T/R POWER INTERRUPT RELAY. (With less than 19 (±1.0)V dc at terminal 3 of the T/R POWER INTERRUPT RELAY, the solid state relay logic gates are closed.)Battery power routed through APU POWER CONTROL RCCB (4961-CB11) and APU CONT SYS voltage regulator(4961-VR1) is applied through the relaxed BATTERY POWER CONTROL relay to the continuous power distribution terminal modules. GEN CUTOUT RELAY (4961-K3) will remain relaxed until APU POWER CONTROL relay (4911-K1, Ref. Fig. 6 Sheet 1) is energized and applies 28V dc power to the ECU. At that time, the ECU will energize the GEN CUTOUT relay and hold it open until 95 percent Nf (free turbine speed) is attained and APU generator output is available for supplying T/R power to the dc ground service busses.

(c) At 95 percent Nf (free turbine speed), the ECU deenergizes the GEN CUTOUT relay. Ground service bus voltage applied through APU INLET DOOR NO. 2 relay (4911-K3) and the GEN CUTOUT relay latches the T/R POWER CONTROL relay in the T/R mode and energizes BATTERY POWER CONTROL relay (4961-K2). Dc ground service bus power is now applied to the ECU and continuous power circuits through the T/R POWER CONTROL relay. With dc ground service bus power applied to te minal 3 of the T/R POWER INTERRUPT relay, the relay logic gates revert to the normally open condition. An APU shutdown which could result from the drop in continuous power voltage to the ECU during the interval that power is being switched from the BAT BUS to the GND SVCE BUS busses, is prevented by the T/R POWER INTERRUPT RELAY which rapidly closes to maintain BAT BUS power to the ECU. The relay reverts to its normally open condition when the continuous power voltage sensed at terminal 3 of the relay is once again higher than 19 (±1.0) V dc.

(d) If the start is initiated with the ground service busses already energized, temporary transfer of continuous power from the BAT BUS to the ground service buses occurs with the energization of APU INLET DOOR NO. 2 relay (4911-K3). This is caused by the application of ground service bus power through the energized AIR INLET DOOR NO. 2 relay and deenergized GEN CUTOUT relay (4961-K3) to the latching coil of T/R POWER CONTROL relay (4961-K14). Latching of the T/R POWER CONTROL relay in the T/R mode completes a circuit that energizes BATTERY POWER CONTROL relay (4961-K2) and cuts off BAT BUS power. Ground service bus power is then applied through the T/R POWER CONTROL relay to the continuous power distribution terminal modules.

(e) With the air inlet door actuator in the full open door position, the APU POWER CONTROL relay is energized and 28V dc power is applied to the ECU. The ECU energizes the GEN CUTOUT relay which removes the holding voltage to the BATTERY POWER CONTROL relay coil. The BATTERY POWER CONTROL relay deenergizes and reapplies BAT BUS power to the continuous power circuits.

(2) Continuous Power Transfer (Aircraft 015-999)

Transfer of the continuous power distribution circuits from BAT BUS to DC GND SVCE BUS (T/R) power occurs as follows:

(a) Placing the MASTER POWER switch to the ON position closes APU BATTERY POWER RCCB (2436-CB3), CONTROLLER POWER RCCB (4961-CB9) and APU POWER CONTROL RCCB (4961-CB11) to voltage regulator (4961-VR1). BAT BUS voltage at the output terminal of voltage regulator (4961-VR1) is applied through relaxed BATTERY POWER CONTROL relay (4961-K2) to the continuous power circuits and to terminal 2 of T/R POWER INTERRUPT RELAY (4961-K15). The solid state 4961-K15 relay at this time is open. BAT BUS voltage from the CONTROLLER POWER RCCB is applied through another set of contacts in the BATTERY POWER CONTROL relay to APU POWER CONTROL relay (4911-K1) where it is available for application to the ECU.

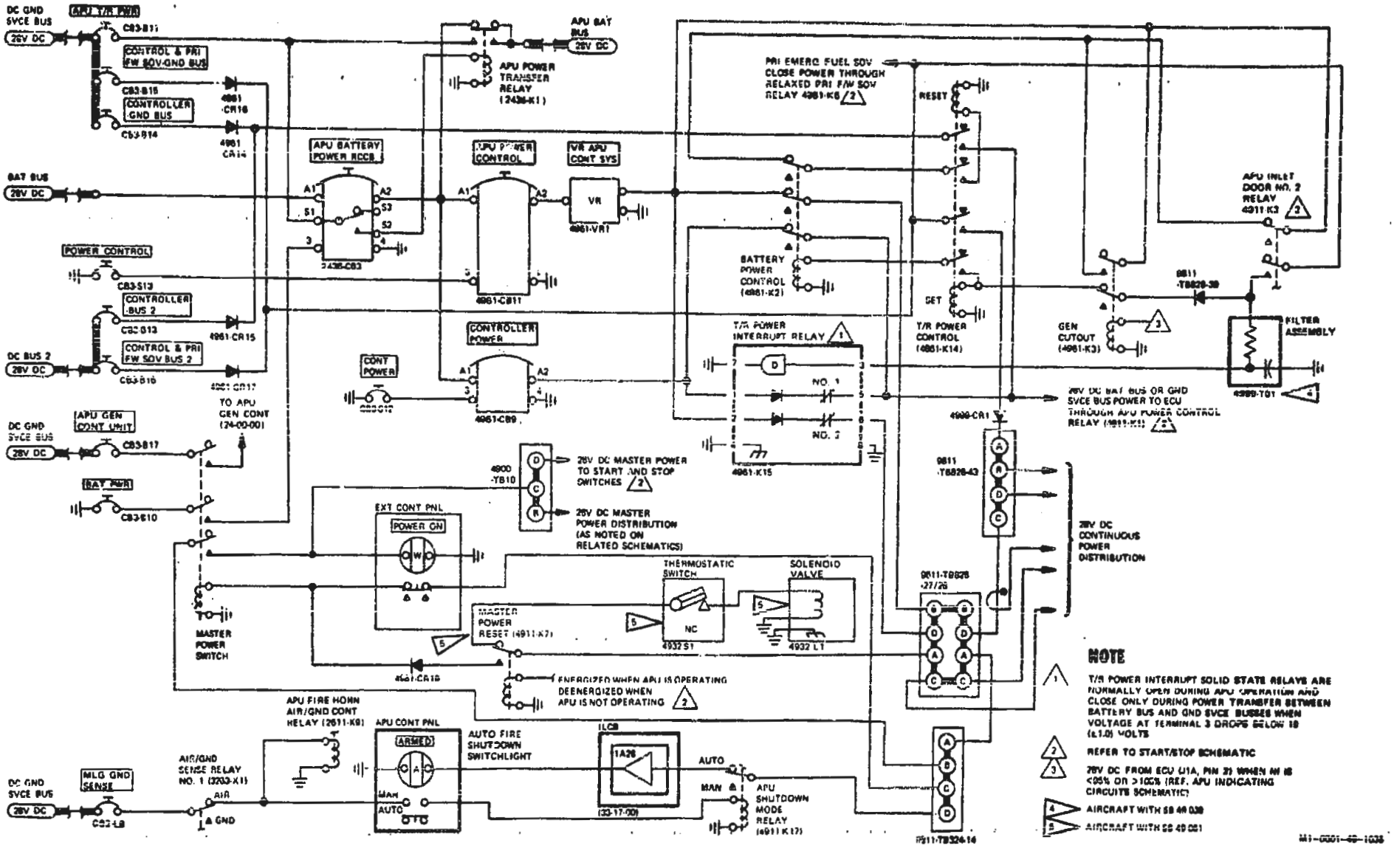
(b) When the APU START button is depressed, APU inlet door relays No. 1 and 2 (4911-K3 and 4911-K4) are energized and the APU air inlet and vent ejector doors are opened. APU POWER CONTROL relay

(4911-K1) is energized, by a 28V dc circuit completed through the closed air inlet door actuator (door closed) limit switch. The relay is electrically latched and 28V dc power is applied through the relay to the ECU.

(c) If the start is initiated with only battery power available, the BATTERY POWER CONTROL relay will remain relaxed until the APU generator is on the line and T/R power is applied to the ground service buses. At that time the BATTERY POWER CONTROL relay will energize and transfer power to the ground service buses. The sudden drop in continuous power voltage during the power transfer is sensed at terminal 3 of T/R POWER INTERRUPT RELAY (4961-K15). As the voltage sensed at terminal 3 drops below 19 (±1.0)V dc, the solid state relay closes. This provides an alternate path for battery power to the continuous power circuits and ECU in the interval that it takes the BATTERY POWER CONTROL relay to transfer the power source. The POWER INTERRUPT RELAY will revert to the normally open condition when the continuous power voltage level sensed at terminal 3 is once again above 19 (±1.0) V dc. If the start is initiated with power already applied to the ground service buses, the BATTERY POWER CONTROL relay is energized.

(3) Power Interrupt Protection

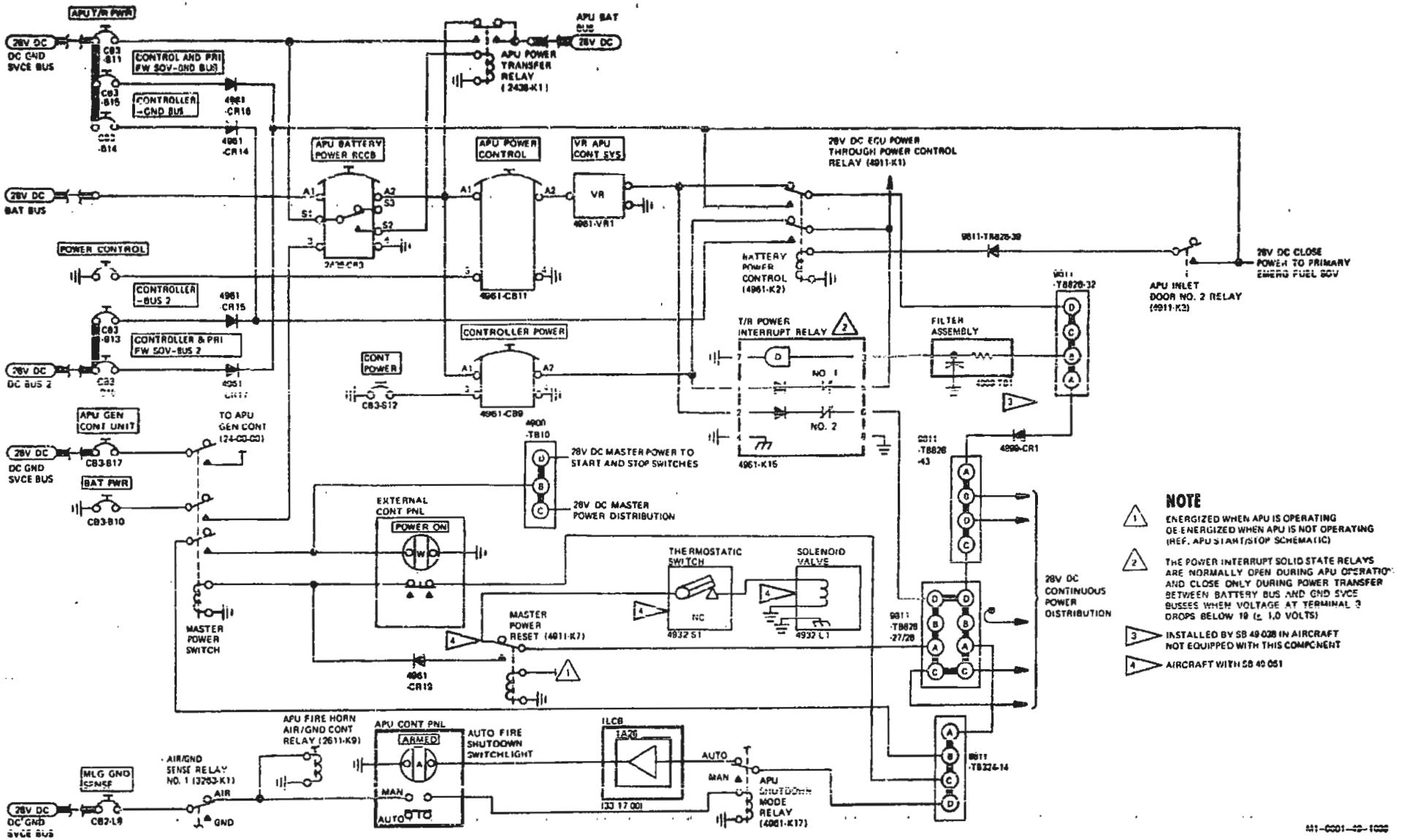
An interruption of APU continuous power to the ECU and APU control circuits will result in an APU shutdown. To prevent this from occurring during the interval when power is being transferred between the aircraft battery and T/R energized ground service busses, a rapid response solid state T/R POWER INTERRUPT RELAY (4961-K15) is wired in parallel with the relatively slower response BATTERY POWER CONTROL relay (4961-K2). With APU master power applied, the solid state relay logic gates are normally open (Ref. Fig. 5). They are rapidly closed whenever the continuous power voltage level sensed at terminal 3 of the relay falls below 19 (±1.0) V dc. When this occurs, an alternate path for battery power is established through the relay to the continuous power distribution circuits. When the continuous power path is once again restored through the BATTERY POWER CONTROL relay, the relay logic gates revert to the normally open condition. A loss of continuous power is thus prevented during power transfers between the aircraft battery and ground service busses.



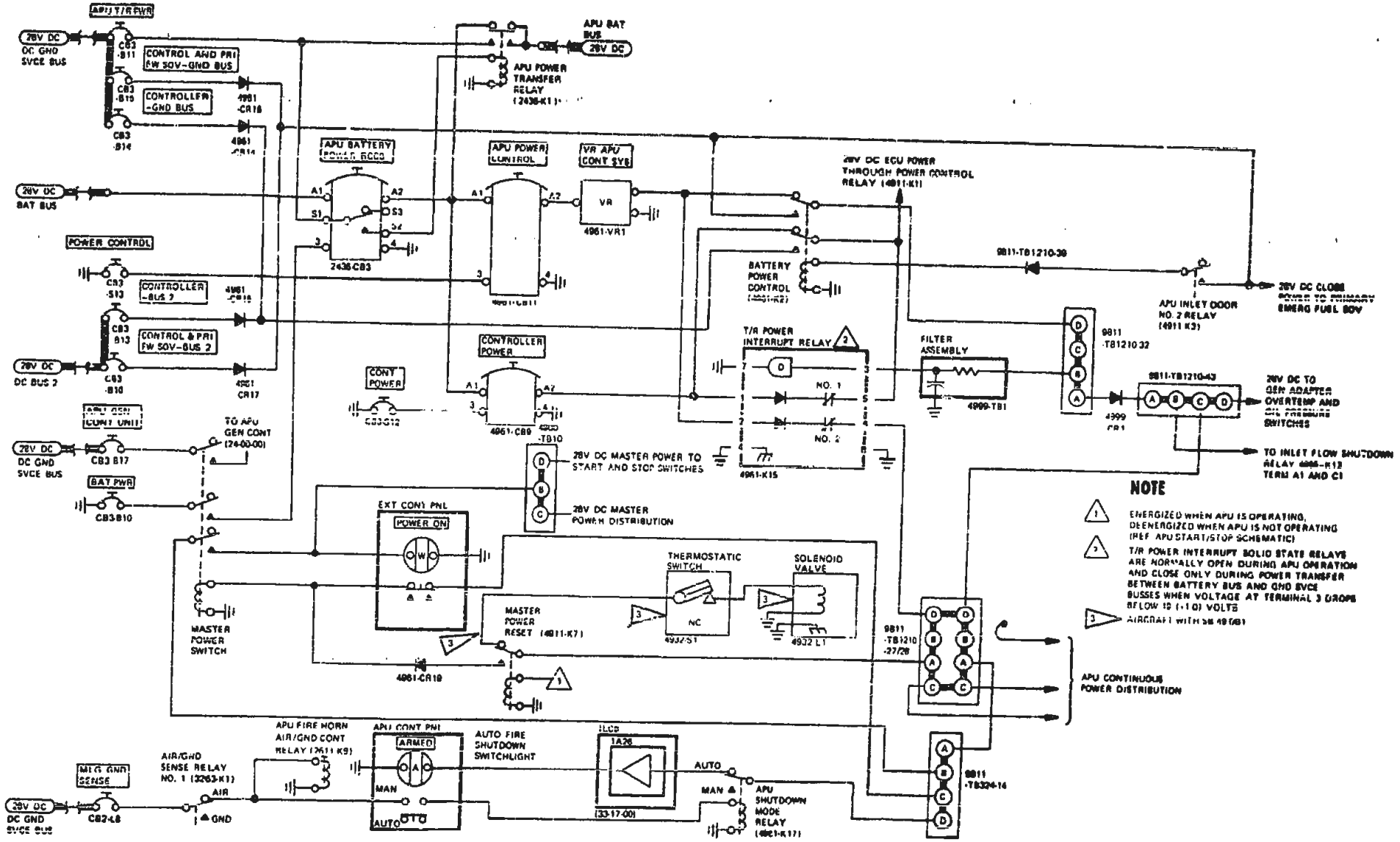
R R APU Power Distribution Functional Schematic
Figure 5

EFFECTIVITY: 001-014

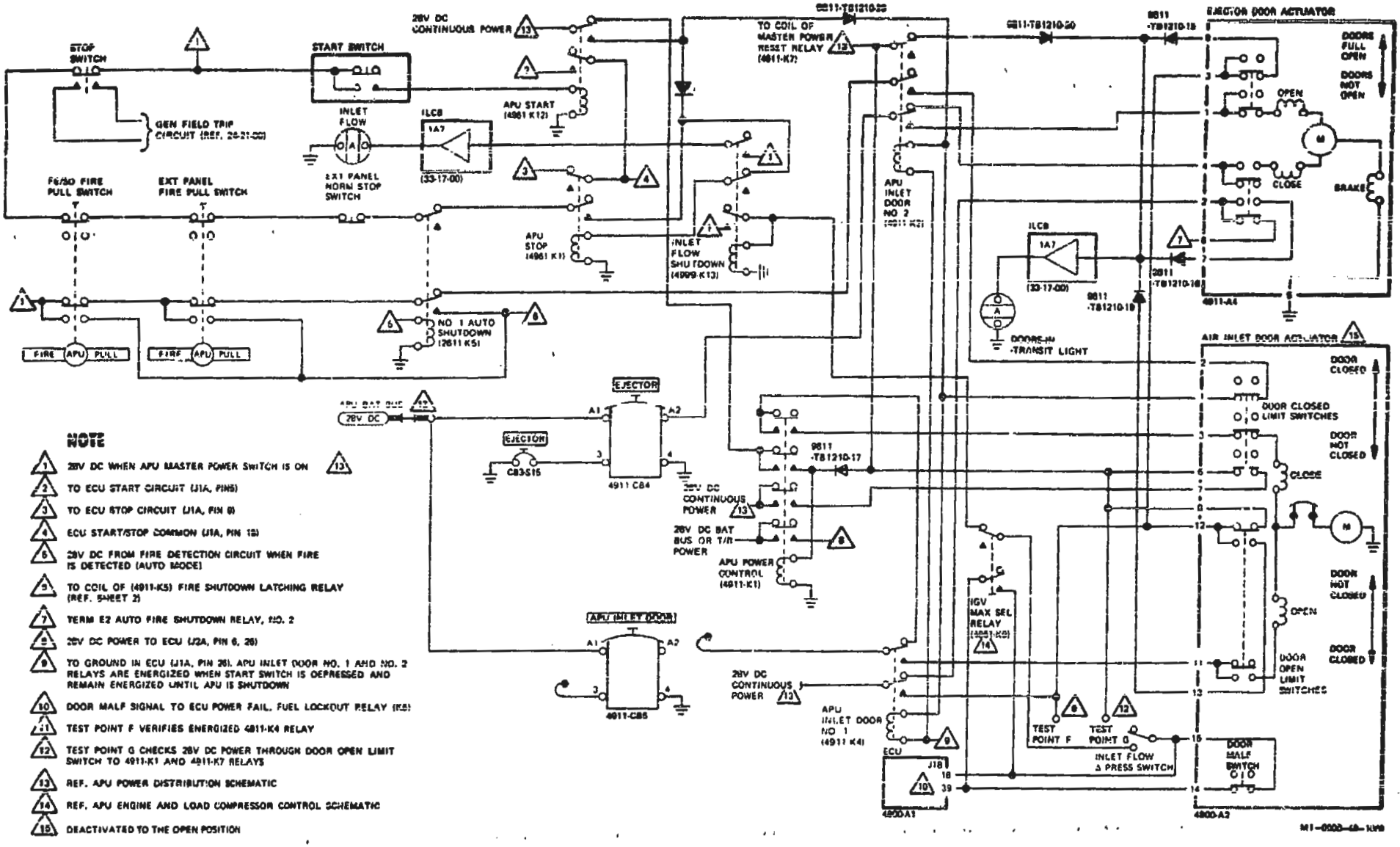
001B



R APU Power Distribution Functional Schematic
R Figure 5



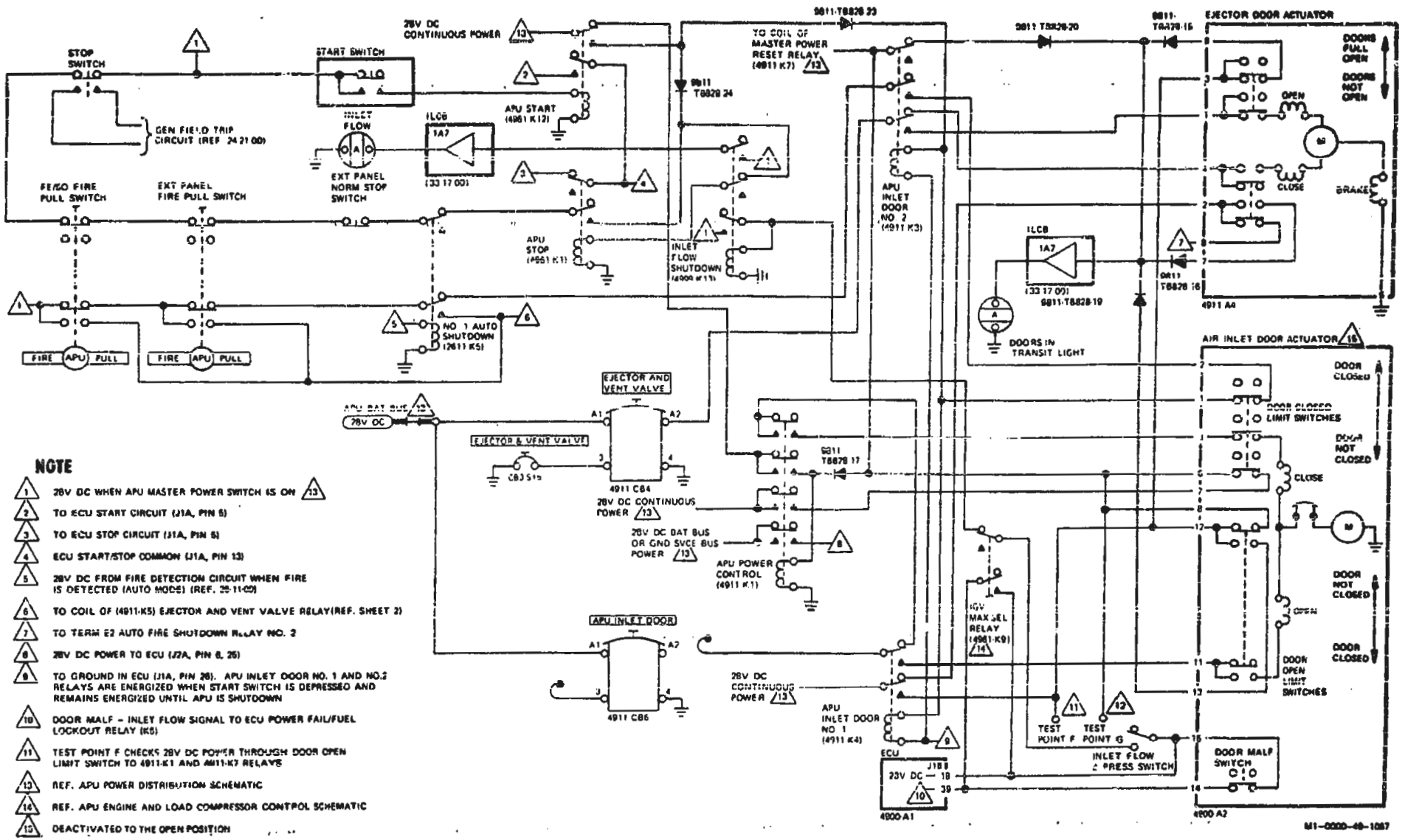
R APU Power Distribution Functional Schematic
R Figure 5



NOTE

1. 28V DC WHEN APU MASTER POWER SWITCH IS ON
2. TO ECU START CIRCUIT (J1A, PIN5)
3. TO ECU STOP CIRCUIT (J1A, PIN 6)
4. ECU START/STOP COMMON (J1A, PIN 15)
5. 28V DC FROM FIRE DETECTION CIRCUIT WHEN FIRE IS DETECTED (AUTO MODE)
6. TO COIL OF (4911-K5) FIRE SHUTDOWN LATCHING RELAY (REF. SHEET 2)
7. TERM E2 AUTO FIRE SHUTDOWN RELAY, NO. 2
8. 28V DC POWER TO ECU (J2A, PIN 6, 26)
9. TO GROUND IN ECU (J1A, PIN 26). APU INLET DOOR NO. 1 AND NO. 2 RELAYS ARE ENERGIZED WHEN START SWITCH IS DEPRESSED AND REMAIN ENERGIZED UNTIL APU IS SHUTDOWN
10. DOOR MALF SIGNAL TO ECU POWER FAIL, FUEL LOCKOUT RELAY (K5)
11. TEST POINT F VERIFIES ENERGIZED 4811-K4 RELAY
12. TEST POINT G CHECKS 28V DC POWER THROUGH DOOR OPEN LIMIT SWITCH TO 4911-K1 AND 4911-K7 RELAYS
13. REF. APU POWER DISTRIBUTION SCHEMATIC
14. REF. APU ENGINE AND LOAD COMPRESSOR CONTROL SCHEMATIC
15. DEACTIVATED TO THE OPEN POSITION

APU Start/Stop Functional Schematic
Figure 6 (Sheet 1)



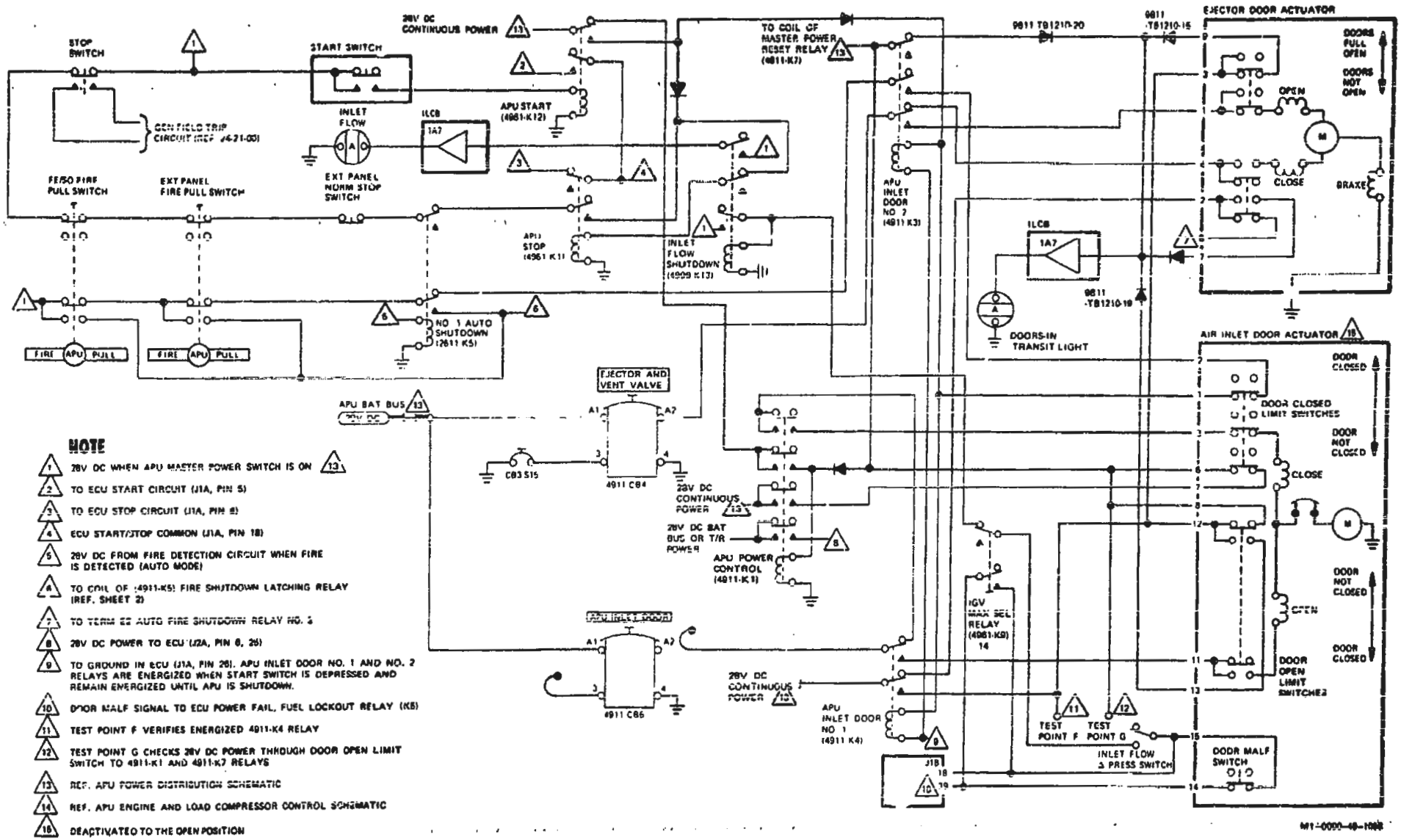
NOTE

1. 28V DC WHEN APU MASTER POWER SWITCH IS ON
2. TO ECU START CIRCUIT (J1A, PIN 6)
3. TO ECU STOP CIRCUIT (J1A, PIN 5)
4. ECU START/STOP COMMON (J1A, PIN 13)
5. 28V DC FROM FIRE DETECTION CIRCUIT WHEN FIRE IS DETECTED (AUTO MODE) (REF. 26-11-00)
6. TO COIL OF (4911-K5) EJECTOR AND VENT VALVE RELAY (REF. SHEET 2)
7. TO TERM E2 AUTO FIRE SHUTDOWN RELAY NO. 2
8. 28V DC POWER TO ECU (J2A, PIN 8, 26)
9. TO GROUND IN ECU (J1A, PIN 26). APU INLET DOOR NO. 1 AND NO.2 RELAYS ARE ENERGIZED WHEN START SWITCH IS DEPRESSED AND REMAINS ENERGIZED UNTIL APU IS SHUTDOWN
10. DOOR MALF – INLET FLOW SIGNAL TO ECU POWER FAIL/FUEL LOCKOUT RELAY (K5)
11. TEST POINT F CHECKS 28V DC POWER THROUGH DOOR OPEN LIMIT SWITCH TO 4911-K1 AND 4911-K7 RELAYS
12. REF. APU POWER DISTRIBUTION SCHEMATIC
13. REF. APU ENGINE AND LOAD COMPRESSOR CONTROL SCHEMATIC
14. DEACTIVATED TO THE OPEN POSITION

R
R

APU Start/Stop Functional Schematic
Figure 6 (Sheet 1)

EFFECTIVITY: 024-031



NOTE

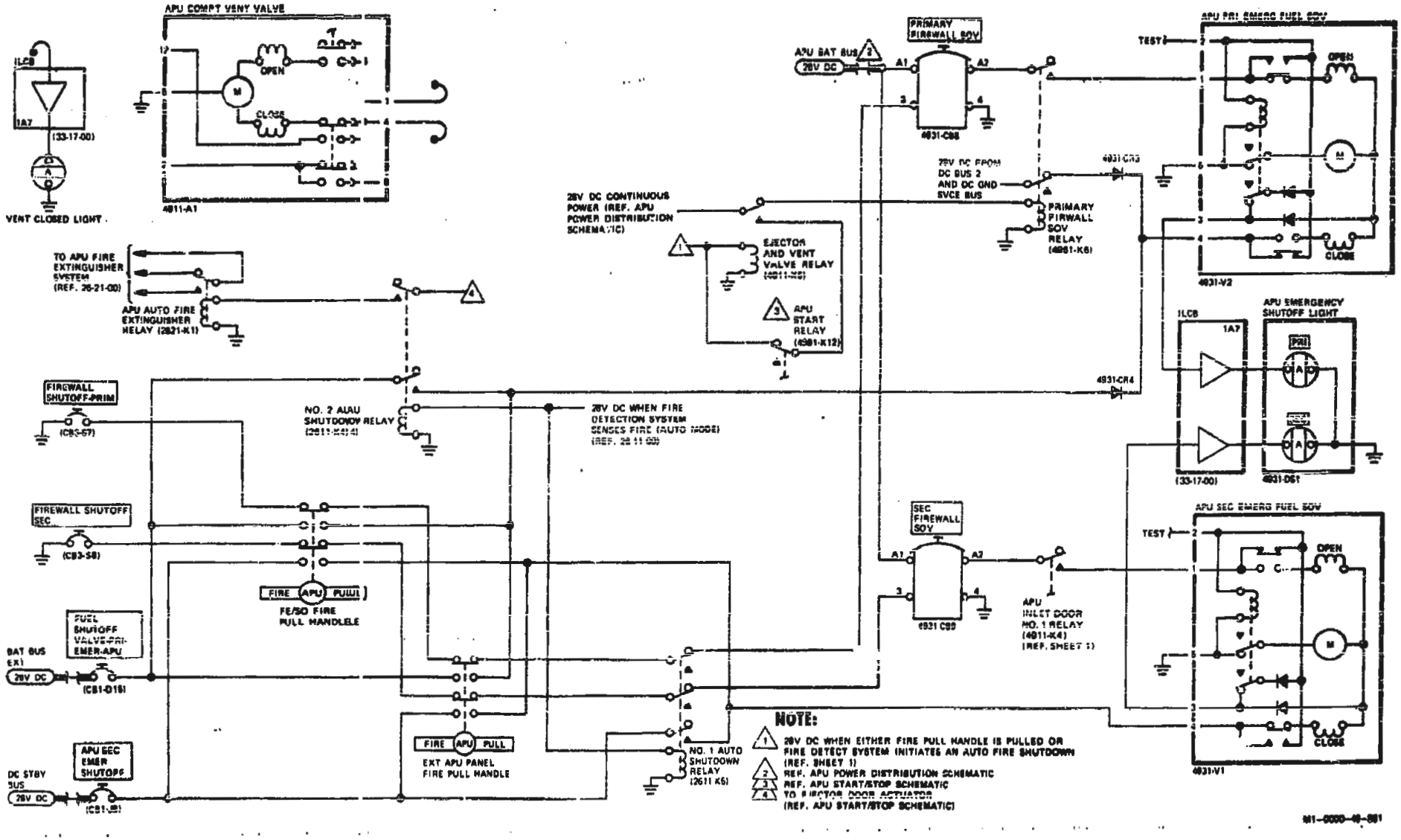
1. 28V DC WHEN APU MASTER POWER SWITCH IS ON (13)
2. TO ECU START CIRCUIT (J1A, PIN 5)
3. TO ECU STOP CIRCUIT (J1A, PIN 6)
4. ECU START/STOP COMMON (J1A, PIN 18)
5. 28V DC FROM FIRE DETECTION CIRCUIT WHEN FIRE IS DETECTED (AUTO MODE)
6. TO COIL OF (4911-K5) FIRE SHUTDOWN LATCHING RELAY (REF. SHEET 2)
7. TO TERM E2 AUTO FIRE SHUTDOWN RELAY NO. 3
8. 28V DC POWER TO ECU (J2A, PIN 8, 26)
9. TO GROUND IN ECU (J1A, PIN 26). APU INLET DOOR NO. 1 AND NO. 2 RELAYS ARE ENERGIZED WHEN START SWITCH IS DEPRESSED AND REMAIN ENERGIZED UNTIL APU IS SHUTDOWN.
10. DOOR MALF SIGNAL TO ECU POWER FAIL, FUEL LOCKOUT RELAY (K5)
11. TEST POINT F VERIFIES ENERGIZED 4911-K4 RELAY
12. TEST POINT G CHECKS 28V DC POWER THROUGH DOOR OPEN LIMIT SWITCH TO 4911-K1 AND 4911-K7 RELAYS
13. REF. APU POWER DISTRIBUTION SCHEMATIC
14. REF. APU ENGINE AND LOAD COMPRESSOR CONTROL SCHEMATIC
15. DEACTIVATED TO THE OPEN POSITION

R
R

APU Start/Stop Functional Schematic
Figure 6 (Sheet 1)

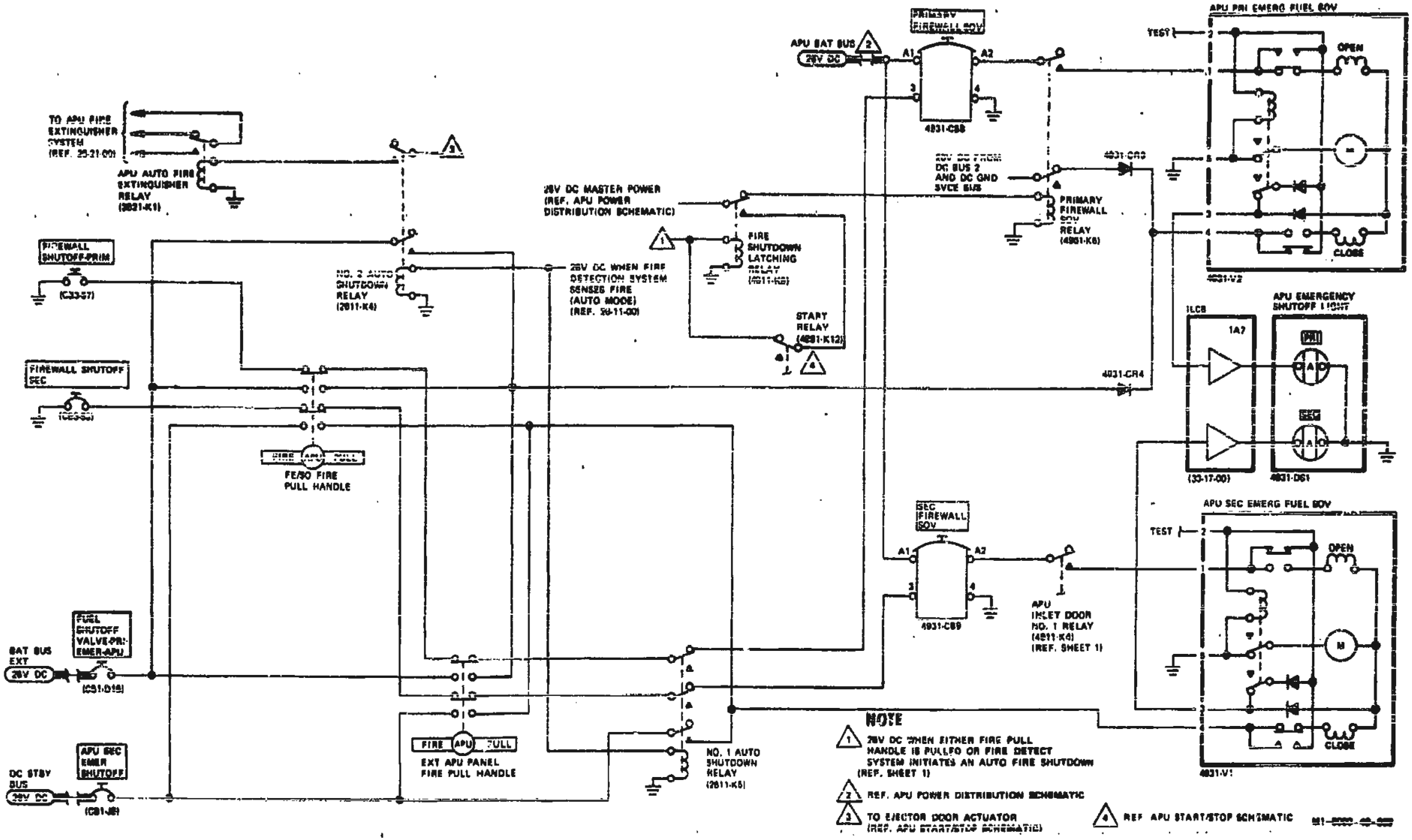
EFFECTIVITY: 032-999

0018



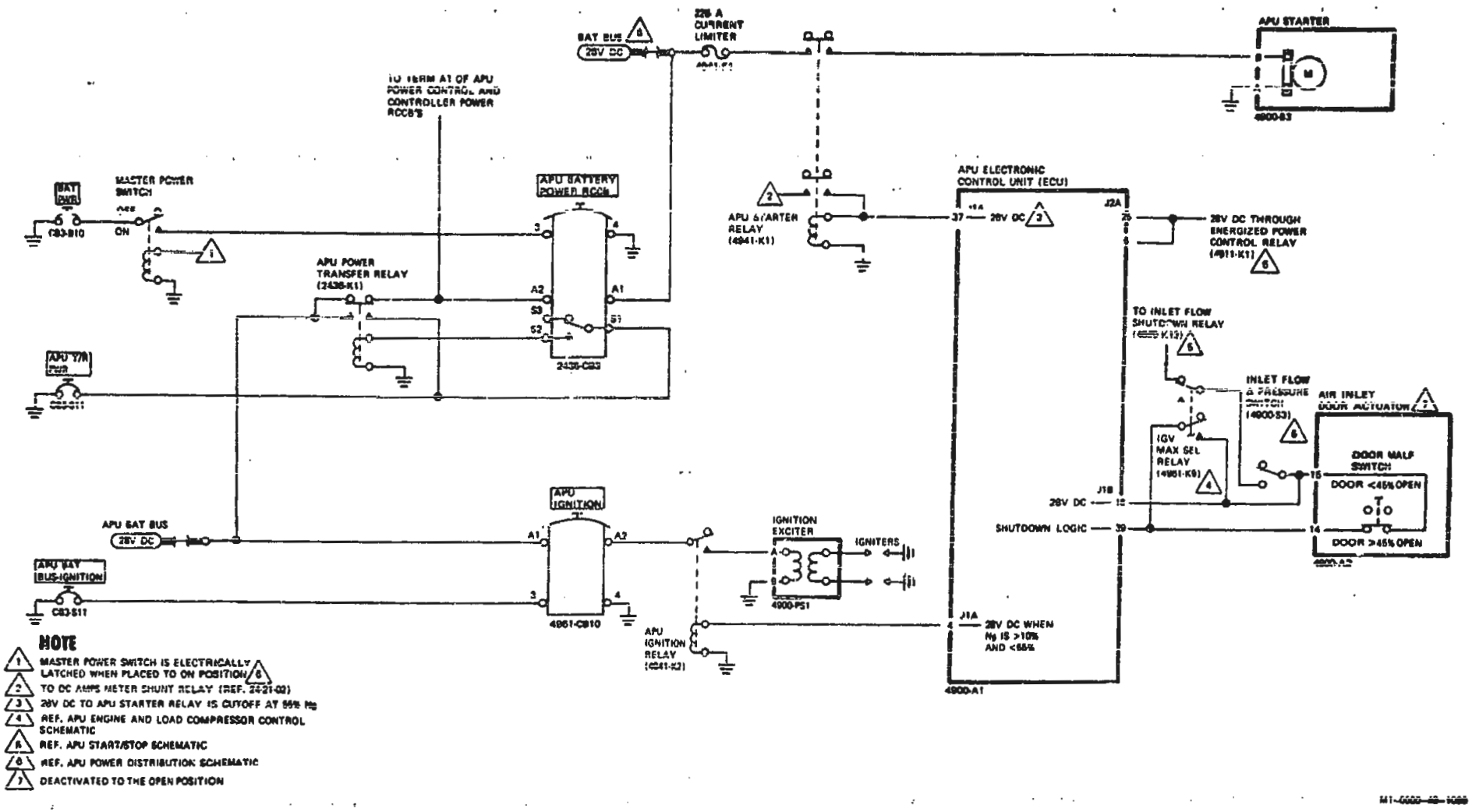
APU Start/Stop Functional Schematic
Figure 6 (Sheet 2)

R EFFECTIVITY: 001-031
R
001B


APU BAT BUS
28V DC
PRIMARY FIREWALL SOV
4931-CB8
APU PRI EMERG FUEL SOV
TEST
OPEN
CLOSE
4931-V2
TO APU FIRE EXTINGUISHER SYSTEM (REF. 26-21-00)
APU AUTO FIRE EXTINGUISHER RELAY (3821-K1)
28V DC MASTER POWER (REF. APU POWER DISTRIBUTION SCHEMATIC)
DC BUS 2 AND DC GND SVCE BUS
4931-CR3
PRIMARY FIREWALL SOV RELAY (4931-K6)
FIREWALL SHUTOFF-PRIM
(C33-57)
NO. 2 AUTO SHUTDOWN RELAY (2811-K4)
28V DC WHEN FIRE DETECTION SYSTEM SENSES FIRE (AUTO MODE) (REF. 26-11-00)
FIRE SHUTDOWN LATCHING RELAY (4811-K2)
START RELAY (4931-K12)
APU EMERGENCY SHUTOFF
ILCB
1A7
4931-CR4
(33-17-00)
4931-D61
FIREWALL SHUTOFF SEC
(C33-58)
FE/SO FIRE PULL HANDLE
SEC FIREWALL SOV
4931-CB9
APU SEC EMERG FUEL SOV
APU INLET DOOR NO. 1 RELAY (4811-K4) (REF. SHEET 1)
BAT BUS EXT 28V DC
FUEL SHUTOFF VALVE-PR-EMER-APU
(CB1-D15)
DC STBY BUS 28V DC
APU SEC EMER SHUTOFF
(CB1-J8)
EXT APU PANEL FIRE PULL HANDLE
NO. 1 AUTO SHUTDOWN RELAY (2811-K5)
4931-V1
NOTE
1 28V DC WHEN EITHER FIRE PULL HANDLE IS PULLED OR FIRE DETECT SYSTEM INITIATES AN AUTO FIRE SHUTDOWN (REF. SHEET 1)
2 REF. APU POWER DISTRIBUTION SCHEMATIC
3 TO EJECTOR DOOR ACTUATOR (REF. APU START/STOP SCHEMATIC)
4 REF. APU START/STOP SCHEMATIC

APU Start/Stop Functional Schematic
Figure 6 (Sheet 2)

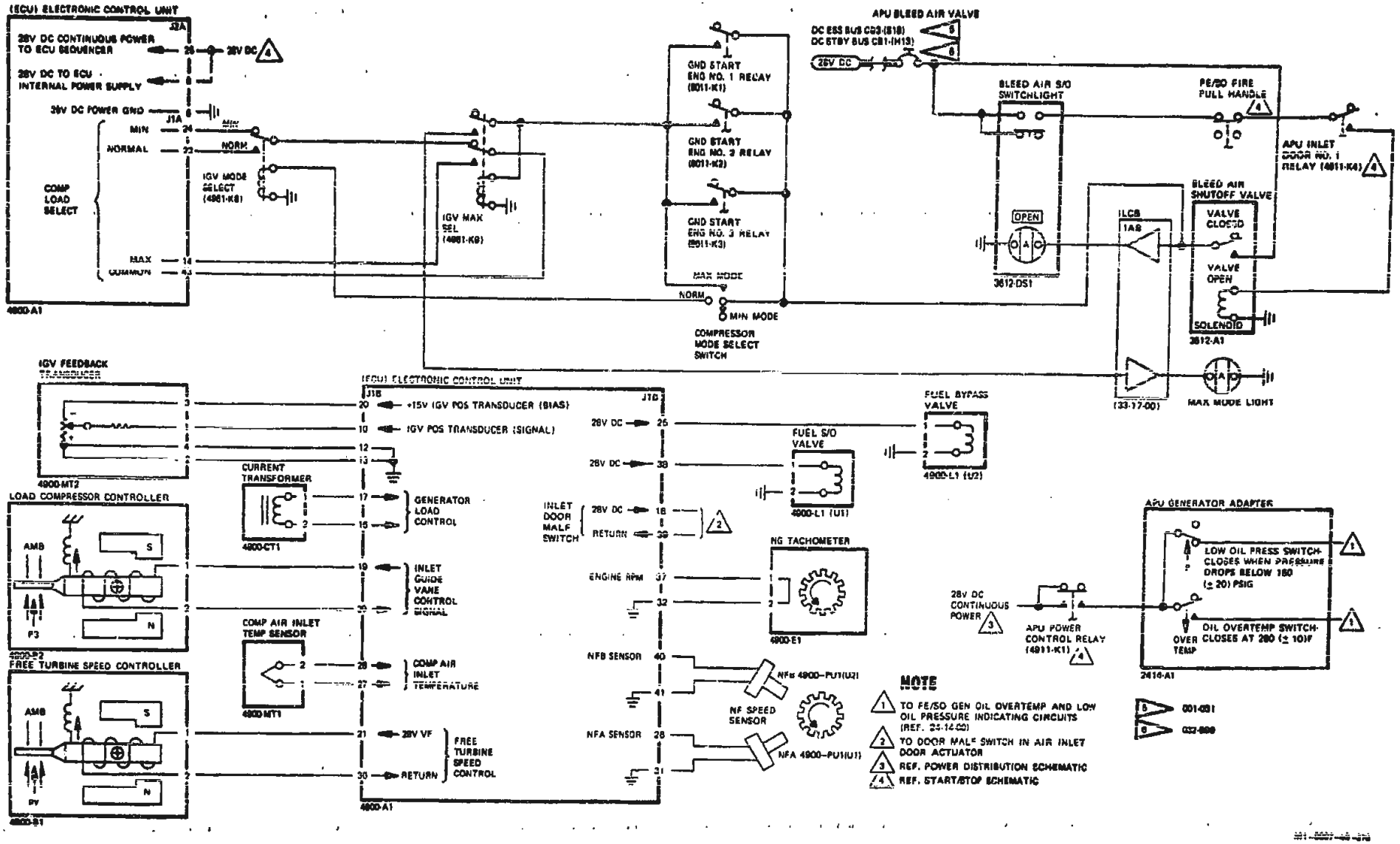
R EFFECTIVITY: 032-999
R
001B



NOTE

1. MASTER POWER SWITCH IS ELECTRICALLY LATCHED WHEN PLACED TO ON POSITION
2. TO DC AMPS METER SHUNT RELAY (REF. 24-21-02)
3. 28V DC TO APU STARTER RELAY IS CUTOFF AT 55% Nφ
4. REF. APU ENGINE AND LOAD COMPRESSOR CONTROL SCHEMATIC
5. REF. APU START/STOP SCHEMATIC
6. REF. APU POWER DISTRIBUTION SCHEMATIC
7. DEACTIVATED TO THE OPEN POSITION

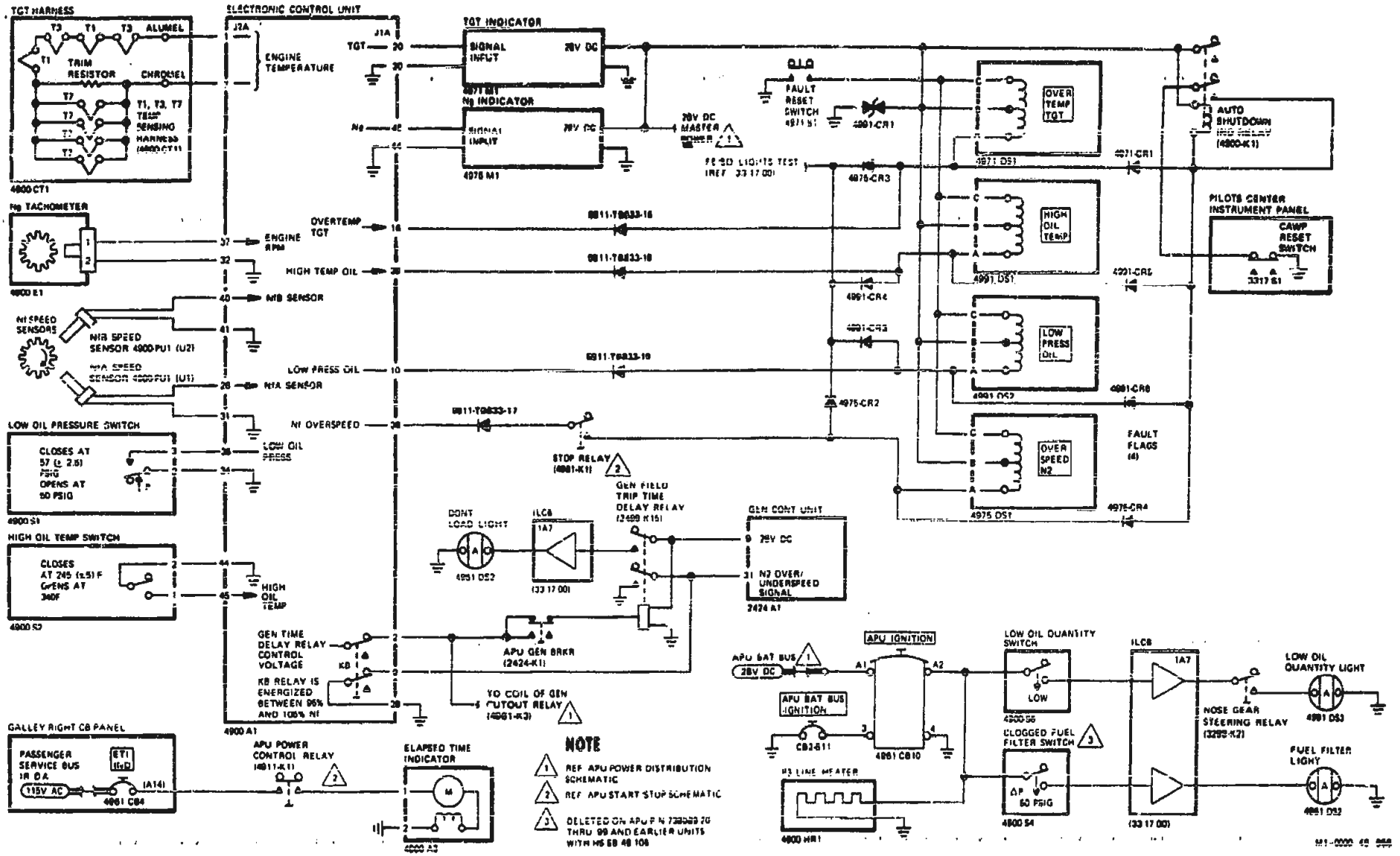
APU Starter and Ignition Functional Schematic
Figure 7



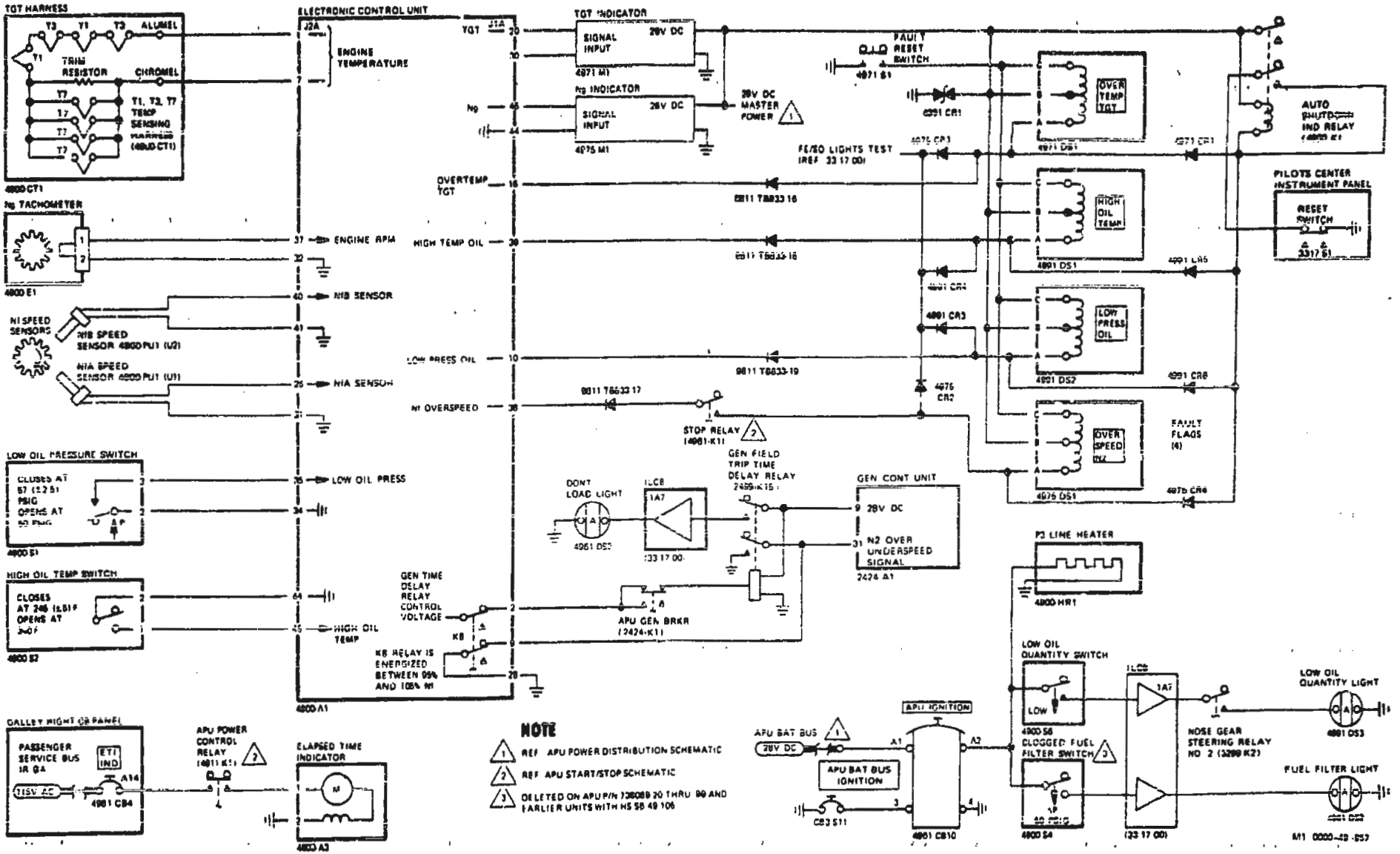
R APU Engine and Load Compressor Control Functional Schematic
R Figure 8

EFFECTIVITY: ALL

001B



APU Indicating Circuits Functional Schematic
Figure 9



APU Indicating Circuits Functional Schematic
Figure 9

(4) APU BAT BUS Transfer

APU POWER TRANSFER RELAY (2436-K1) (Ref. Fig. 5) controls the 28V dc power source used to energize the APU BAT BUS. The relay, when deenergized, applies aircraft battery power to the APU BAT BUS. When APU master power is applied, the relay is energized and the APU BAT BUS is connected to the DC BUS 2 and DC GND SVCE BUS busses.

(5) Voltage Regulator

Voltage regulator (4961-VR1) is mounted on the APU EQUIPMENT AND POWER CONTROL PANEL in the AEEA zone 164. The regulator, operating primarily as a voltage limiter, protects the APU indicator lamps and APU circuit relays from being damaged by voltage surges induced by the battery charger when aircraft battery voltage is applied to the APU control circuits (Ref. Fig. 10).

Regulator P/N 1593360-101 incorporates internal circuitry which protects the unit from being damaged in event the regulator output terminal is shorted to ground. This unit is an authorized spares replacement for the P/N 1559156-101 regulator which does not have this provision.

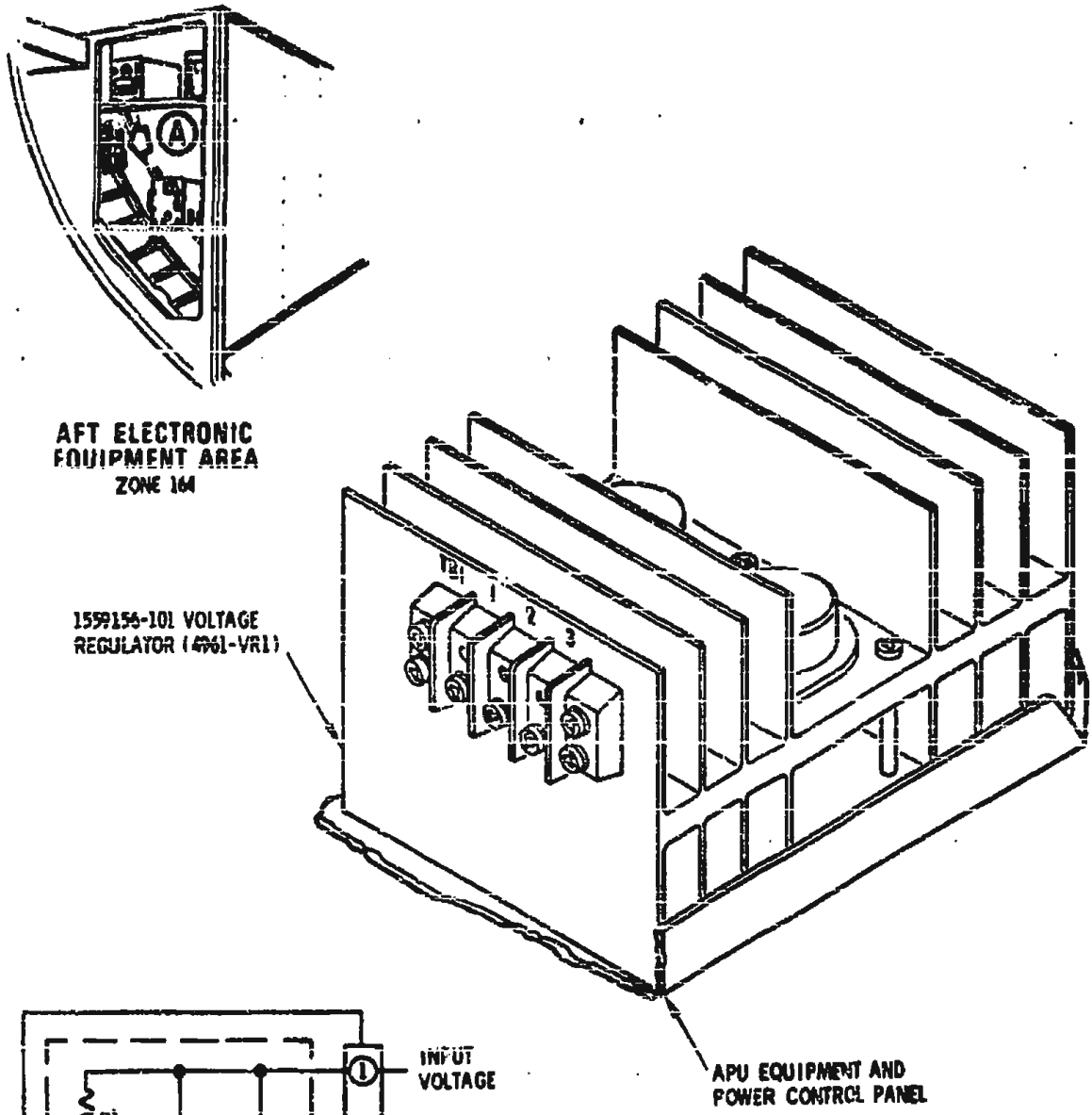
6. APU Operation

A. General

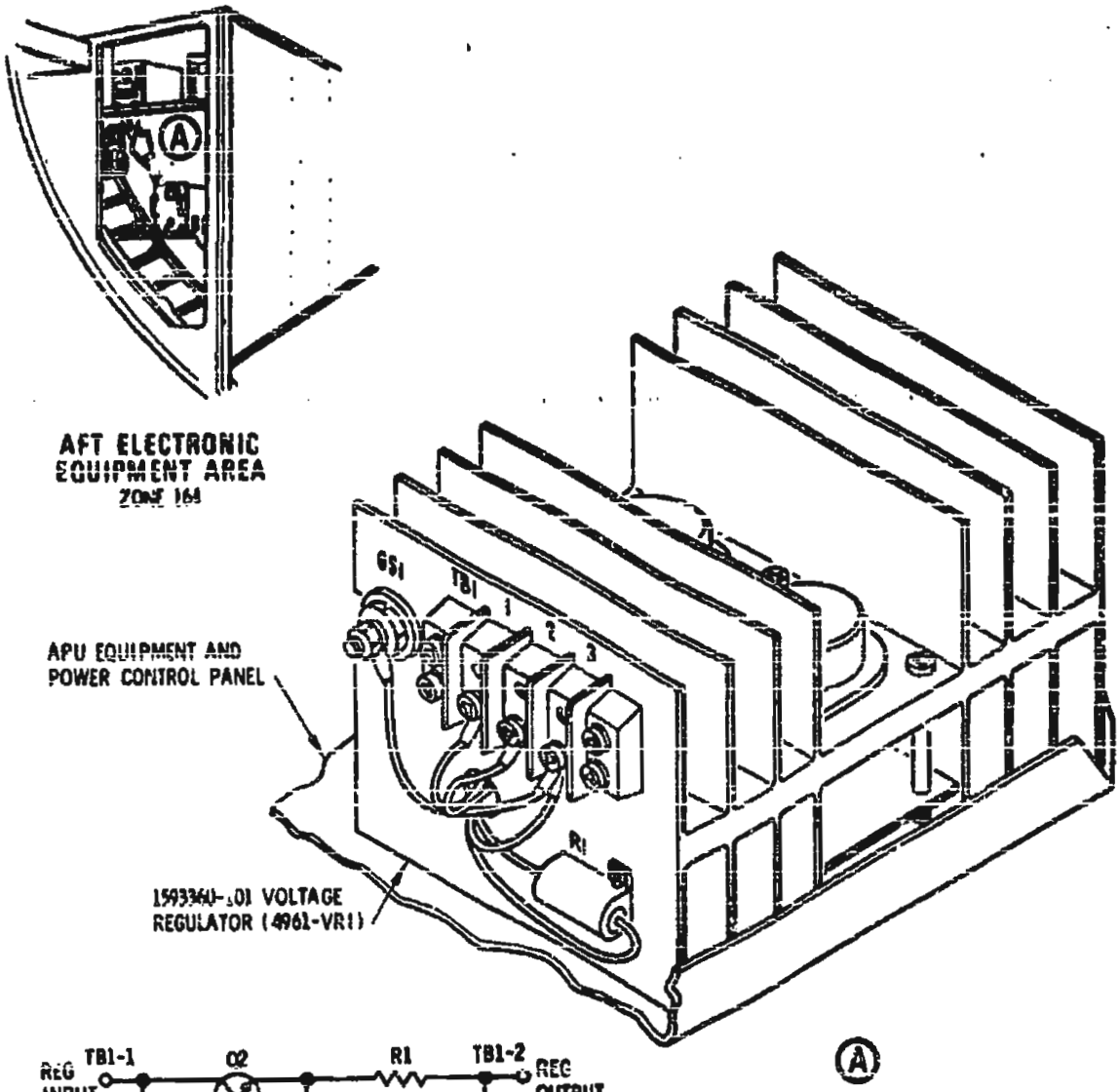
Operation of the auxiliary power plant system will be described by outlining the sequence of events that occur when the system is placed in operation, followed by an explanation of the electrical system functions that control these events. Figures 5 through 9 contain simplified functional schematics of the circuits described in the text. Except for the actuation of APU master power, start and stop, and mode selection switches, all sequential events required to start and accelerate the APU to a stabilized operating point, and maintain stable operation under varying load conditions, are automatically controlled by the electronic controller (ECU).

B. MASTER POWER ON

Placing the MASTER POWER switch in the ON position (Ref. Fig. 5) completes the APU BATTERY POWER RCCB (2436-CB3) remote control circuit and applies BAT BUS voltage to the APU BAT BUS through contacts of deenergized APU POWER



R R Voltage Regulator (4961-VR1)
Figure 10



1593360-101 VOLTAGE REGULATOR SCHEMATIC

Voltage Regulator (4961-VR1)
Figure 10

EFFECTIVITY: 026-999

TRANSFER RELAY (2436-K1). If 28V dc power is already applied to the dc ground service buses, DC GND SVCE BUS power applied through the S1-S2 terminals of the APU BATTERY POWER RCCB will energize the APU POWER TRANSFER RELAY and apply 28V dc power to the APU BAT BUS. With the APU BAT BUS energized, the LOW OIL QUANTITY and FUEL FILTER light circuits are armed.

Battery power is applied through APU POWER CONTROL RCCB (4961-CB11), APU VOLTAGE REGULATOR (4961-VR1), and relaxed contacts of BATTERY POWER CONTROL relay (4961-K2) to the 28V dc continuous power distribution terminal modules (Ref. Fig. 5).

NOTE: The acquisition and transfer of APU continuous power between the aircraft BAT BUS and dc ground service busses during an APU start is described in Paragraph 5H.

T/R POWER INTERRUPT RELAY (4961-K15) is a rapid response solid state switching device which prevents loss of APU power during the interval that BATTERY POWER CONTROL relay (4961-K2) is in-transit between dc ground service and battery power positions. The solid state relay gates are open when the voltage at terminal 3 is greater than 19 (±1.0) volts and closed when less than 19 (±1.0) volts.

BAT BUS voltage is applied through CONTROLLER POWER RCCB (4961-CB9) and BATTERY POWER CONTROL relay (4961-K2) to the 28V dc continuous power distribution terminal modules and to APU POWER CONTROL relay (4911-K1) to the 28V dc where it is available for powering the ECU when the APU POWER CONTROL relay is energized.

The APU MASTER POWER switch is held engaged by a solenoid which is energized by 28V dc continuous power applied through the APU EXTERNAL CONTROL panel POWER ON switchlight (Ref. Fig. 5). A 28V dc circuit completed through the master power switch illuminates the POWER ON legend to provide an external control panel indication that APU master power is on.

On aircraft with SB49-061,
a solenoid valve is energized to the open position which ports hot engine bleed air to the accessory end of the APU. Engine bleed air is tapped from the engine side of the APU isolation valve and routed through the APU forward fire wall to a discharge nozzle. Bleed air melts ice or prevents freezing of water trapped in the fuel components. The solenoid valve deenergizes to the closed position when the momentary START switch button is depressed. The PRIMARY

FIREWALL SOV relay (4961-K6) is energized by 28V dc continuous power applied through the MASTER POWER switch and relaxed relay 4911-K5 (Ref. Fig. 5 and 6). The primary emergency fuel shutoff valve is commanded to open by APU BAT BUS voltage applied through PRIMARY FIREWALL SHUTOFF RCCB (4911-CB8) and the energized PRIMARY FIREWALL SOV relay (4961-K6).

NOTE: The APU primary emergency fuel shutoff valve is commanded to close whenever the dc ground service buses are energized and the PRIMARY FIREWALL SOV relay is deenergized.

A close command voltage from the APU BAT BUS is applied through RCCB 4911-CB4 and deenergized APU INLET DOOR NO. 2 relay (4911-K3) to the air vent ejector door actuator (Ref. Fig. 6). If open, closing of the ejector doors is indicated by the DOOR IN TRANSIT light.

The APU EMERGENCY SHUTDOWN ARMED light (Ref. Fig. 5) is turned on by 28V dc continuous power applied through relaxed contacts of AUTOFIRE SHUTDOWN MODE relay (4961-K17).

The ECU is normally externally set to operate the APU in MIN MODE (Ref. Fig. 8) by a circuit completed through deenergized IGV MAX SEL relay (4961-K9) and IGV MODE SEL relay (4961-K8). The APU will respond to compressor mode select switch NORM and MAX MODE positions only when the BLEED AIR S/O switchlight is depressed (OPEN light on) and the bleed air shutoff valve is opened. This can occur only after APU INLET DOOR NO. 1 relay (4911-K4) is energized. 28V dc from the DC ESS BUS is applied to the compressor mode select switch through the OPEN light control switch in the bleed air shutoff valve.

With the compressor mode select switch in NORM position, IGV MODE SELECT relay (4961-K8) is energized and the ECU is commanded to operate the APU in NORM mode by a circuit completed through contacts of the deenergized IGV MAX SEL relay. When MAX MODE is selected, the IGV MODE SEL relay is deenergized and the IGV MAX SEL relay energized. The ECU is commanded to operate the APU in MAX MODE by a circuit completed through contacts of the energized IGV MAX SEL relay. MAX MODE operation during an engine start with the compressor mode select switch in MIN MODE or NORM position is commanded in the same manner by closure of an engine ground start relay.

C. APU Start

R Depressing the momentary START switch button (Ref. Fig. 6) initiates the APU start cycle. When the START switch is

R depressed, the DOOR IN TRANSIT light only indicates opening
R of the air vent ejector doors and an APU start will be
R initiated the moment the START switch is depressed. With the START switch depressed, APU START relay (4961-K12) is energized and the following events occur:

(1) APU STOP relay (4961-K1) is energized by 28V dc master power and is electrically latched by a circuit made through the APU CONTROL panel STOP switch, the external control panel NORM STOP switch, both APU FIRE PULL switches, and NO. 1 AUTO SHUTDOWN relay (2611-K5).

(2) Continuity is established between the ECU start and start/stop common circuits through contacts in the APU START relay. This resets the timers in the ECU sequencing circuits.

(3) With the APU STOP relay energized, the stop command circuit to the ECU is opened.

(4) The Nf overspeed shutdown indication circuit in the ECU is armed.

(5) APU INLET DOOR RELAY NO. 1 (4911-K3) and APU INLET DOOR NO. 2 relay (4911-K4) are initially energized by 28V dc master power through the APU START relay. The relays are held energized by a circuit made through the APU FIRE PULL handles, relaxed NO. 1 AUTO SHUTDOWN relay (2611-K5), energized APU INLET DOOR NO. 2 relay (4911-K3) and the air inlet door not closed switch. The ground for this circuit is established in the ECU.

When the air inlet door control relays are energized, the following events occur:

R (1) A circuit is completed through fire pull handles, NO. 1 AUTO SHUTDOWN relay (2611-K5), and APU INLET DOOR NO. 2 relay (4911-K3) that electrically holds both air inlet door relays in the energized position and permits release of the START switch. With the switch released, the APU START relay deenergizes.

R (2) The air vent ejector door actuator (Ref. Fig. 6) receives 28V dc power from the APU BAT BUS through RCCB 4911-CB4 and APU INLET DOOR NO. 2 relay (4911-K3) and the ejector doors are driven open.

R (3) A 28V dc continuous power circuit is completed through
R the energized AIR INLET DOOR NO. 1 relay (4911-K3) to
R turn on the DOOR IN TRANSIT light through (not open)
R contacts of the open position limit switch in the
R ejector door actuator. Simultaneously, the APU POWER

R CONTROL RELAY (4911-K1) and MASTER POWER RESET relay
R (4911-K7) are energized.

(5) On aircraft 001-014, the T/R POWER CONTROL relay reset coil circuit (Ref. Fig. 5) made through APU INLET DOOR NO. 2 relay is
R disarmed. When the air vent ejector doors are fully opened, the actuator door limit switches move to the doors open position. Power to the actuator open coil and DOOR IN TRANSIT light circuit made through the ejector door actuator is removed and the DOOR IN
R TRANSIT light goes off. With the air vent ejector
R doors fully open, the close limit switches inside the
R door actuator are armed for a door closed operation.

With APU POWER CONTROL (4911-K1) relay energized, the following events occur:

(1) The air inlet door close circuit contacts in the relay are armed (Ref. Fig. 6).

(2) A 28V dc continuous power latching voltage is applied to the coil of the APU POWER CONTROL relay through the relaxed APU START relay and energized contacts of the POWER CONTROL relay.

(3) 115V ac power from the ETI IND circuit breaker is applied through the APU POWER CONTROL relay to the APU elapsed time indicator (Ref. Fig. 9).

(4) 28V dc continuous power is applied through the APU POWER CONTROL relay to the APU generator oil pressure and temperature indicating circuits (Ref. Fig. 6 and 8).

(5) 28V dc power is applied to the ECU through the APU POWER CONTROL relay (Ref. Fig. 8).

With 28V dc power applied to the ECU, the ECU sequencer commences the APU start cycle. The ECU initiates the following events:

(1) The DONT LOAD light legend comes on (Ref. Fig. 9).

(2) A ground is provided for the generator control unit (GCU) to keep the APU generator off the line until the APU has accelerated to 95 percent Nf.

(3) The APU low oil pressure shutdown circuit in the ECU is disabled and the overtemp TGT shutdown circuit is set to a lower (APU start) limit of 760 degrees C.

(4) The ECU switches a simulated 112.5 percent Nf feedback signal (2.5 percent Nf overspeed) into the gas generator speed control system. This signal drives the torque motor flapper in the free turbine speed controller to the full closed position and establishes the engine start fuel flow required to accelerate the engine into the idle speed range.

(5) The start/stop timer in the ECU is activated.

(6) The starter control sequencing circuit in the ECU is energized (Ref. Fig. 7). This provides a 28V dc power output signal which energizes the APU STARTER RELAY (4941-K1). BAT BUS voltage is applied through a 225-amp current limiter and the energized APU STARTER RELAY to the APU starter.

(7) On aircraft 001-014, the GEN CUTOUT relay (4961-K3) (Ref. Fig. 5) is energized. If the ground service buses are powered, the continuous power circuits which were transferred to the ground service buses when the air inlet door control relays were energized are transferred back to the BAT BUS.

When the ECU receives a signal from the Ng tachometer that indicates the gas generator speed has has reached 10 percent Ng, it initiates the following events:

(1) APU IGNITION relay (4941-K2) is energized (Ref. Fig. 7) and APU BAT BUS power is applied to the ignition exciter.

(2) The fuel shutoff valve and fuel bypass valve solenoids (Ref. Fig. 8) mounted on the automatic fuel shutoff valve unit are energized. The fuel shutoff valve opens and the fuel bypass valve closes. The fuel distribution manifold is pressurized and fuel is admitted to the engine combustion chamber. Light-off occurs at approximately 16 to 18 percent Ng speed.

(3) A power fail-fuel lockout relay in the ECU is energized and the ECU power interrupt/loss system shutdown circuit is armed.

(4) The engine begins to accelerate to its normal operating speed.

When the ECU receives input signals from the Ng tachometer indicating that Ng has risen higher than 55 percent before the start/stop timer has run down, the ECU sequencer simultaneously initiates the following events:

(1) The ECU fail to start timer is deactivated.

(2) The ECU low oil pressure and loss of NfA (free turbine speed) shutdown circuits are armed.

(3) The overtemp TGT shutdown circuit in the ECU is reset to a higher normal operating temperature limit (1060 degrees C) and the temperature limiting Ng override circuit is enabled (P/N 2724438-8 ECU's). P/N 724438-10 and later ECU's incorporate a variable TGT limiting schedule which rises linearly at 70 percent Ng to 95 percent Ng and a TGT modulation circuit which will cut back fuel flow and a limit maximum TGT to a nominal value of 1037 C in MIN and NORM modes and 1050 C when in MAX MODE.

(4) APU IGNITION relay (4941-K2) is deenergized and ignition is terminated (Ref. Fig. 7).

(5) APU STARTER RELAY (4941-K1) is deenergized and starter operation is terminated (Ref. Fig. 7).

(6) The simulated 112.5 percent Nf feedback reference in the ECU is switched to a simulated 97.5 percent Nf feedback reference. This establishes a 2.5 percent low Nf speed error signal which is processed in the ECU to produce a signal to the free turbine speed controller commanding an increase in fuel flow to the engine. At 97.5 percent Nf speed, the simulated Nf underspeed signal is replaced by the actual Nf speed sensed by the free turbine speed sensors and a closed loop control system is established to regulate engine power output as required to maintain Nf at 33,000 rpm.

(a) If the start/stop timer in the ECU lapses before the gas generator has reached 55 percent Ng, the ECU initiates an automatic shutdown cycle. Fuel flow and ignition are terminated, as in a normal shutdown. A 10-second timer in the ECU keeps the starter in operation to purge the engine of combustible gases. A shutdown under these conditions will be terminated with the air inlet door and vent air ejector doors in the open position. A restart may be attempted with the doors open provided adequate time (60 seconds minimum) is allowed for starter cooling.

(b) If the doors are to be closed, it is done by first depressing the STOP button switch. When the DOOR IN TRANSIT light indicates that the doors have closed, the MASTER POWER switch is then placed to the OFF position.

(c) In event the APU start is aborted prior to 55 percent Ng, the starter will continue to crank the engine (with fuel and ignition on) until the fail to start timer in the ECU lapses. At that time fuel flow and ignition is terminated and the starter continues to crank the engine for an additional 10 (±2) seconds to purge the engine and the APU coasts to a stop. If the start is aborted after engine speed has risen higher than 55 percent Ng, the APU will run at 63 percent idle speed until an 80-second timer in the ECU runs down. The APU will then proceed to a normal shutdown.

When the ECU speed control circuit senses 95 percent Nf speed, the ECU sequencer simultaneously initiates the following events:

(1) An input signal from the NfB speed sensor energizes a relay in the ECU which replaces the simulated 97.5 percent Nf reference with the actual NfA speed sensor signal. The ECU Ng speed control circuit then regulates Ng to whatever speed is necessary to maintain Nf at 100 percent (33,000 rpm).

(2) The DONT LOAD light (put out by the NfB sensor between 95 and 105 percent Nf) goes off (Ref. Fig. 9).

(3) The electrical ground to the generator control unit is removed and the generator comes on the line.

(4) On aircraft 001-014, the GEN CUTOUT relay is deenergized and the continuous power circuits are transferred to T/R power.

During an APU start, APU generator operation is inhibited and the APU DONT LOAD light circuit is energized by the K8 relay in the APU electronic control unit until free turbine speed (Nf) has reached 95 percent N2 (Ref. Fig. 9). At 95 percent N2, the relay turns off the DONT LOAD light and removes the generator inhibit signal (Ref. 24-24-00).

In operation, the K8 relay (when deenergized) provides a ground at the APU generator control unit (GCU) electrical connector, pin 31, which prevents the GCU from putting the generator on the line. It also applies 28V dc to the DONT LOAD light circuit to illuminate the DONT LOAD light on the APU CONTROL panel. When the relay is energized, the ground at the GCU, and the 28V dc power to the DONT LOAD light is removed. The light goes out and the GCU pulls in the APU generator breaker to put the generator on the line. The K8 relay is energized whenever a signal from the NfB free

turbine speed sensor to the APU electronic control unit indicates that Nf speed is between 95 percent and 105 percent.

To avoid an undesirable transient in generator output that can occur before APU operation has stabilized, a GENERATOR FIELD TRIP TIME DELAY RELAY (2499-K15) is incorporated in the APU generator control circuit.

During an APU start, the time delay relay (Ref. Fig. 9) is energized by 28V dc from the APU GCU at terminal X1. A 28V dc control voltage applied through the deenergized K8 relay in the APU electronic control unit and the relaxed APU generator breaker (2421-K1) is applied to terminal C1 and enables energization of the time delay relay. The K8 relay also makes a ground which prevents the GCU from pulling in the APU generator breaker and putting the generator on the line. With the time delay relay energized, an alternate GCU ground is made through contacts A1-A2 of the relay. 28V dc from the GCU applied through contacts B1-B2 turns on the DONT LOAD light on the APU CONTROL panel.

When APU free turbine speed reaches 95 percent Nf, the K8 relay is energized. This removes the GCU ground in the electronic control unit and the 28V dc time delay relay control voltage. The APU generator is now kept off the line by the ground created through the time delay relay. With the control voltage removed the time delay relay begins to time out. The 5 to 7 seconds taken by the relay to relax provides time for free turbine speed to stabilize before the generator load is applied to the APU.

When the time delay relay relaxes, the ground is removed from the GCU and the GCU pulls in the generator breaker and puts the generator on the line. The 28V dc applied to the DONT LOAD light is simultaneously removed and the light goes off. The time delay relay remains relaxed until the K8 relay is once again deenergized and 28V dc control voltage is applied to terminal C1. This occurs whenever Nf (free turbine speed) drops below 95 percent N2 (as in a normal APU shutdown) or an Nf overspeed condition is sensed by the NfB (or NfA) free turbine speed sensors.

D. APU STOP

The APU can be shut down by any one or more of the following events:

(1) A normal shutdown initiated by depressing the STOP switch button on the APU CONTROL panel or the NORM STOP switch button on the APU EXTERNAL CONTROL panel.

(2) Tripping of one or more of the fault detection and emergency shutdown circuits (Ref. Para. 5F and 5G).

(3) A loss of ECU electrical power for more than 5 milliseconds.

R (4) Any malfunction that cuts off fuel flow to the APU engine.

R (5) Activation of the automatic fire detection and extinguishing system or manual operation of the fire pull handle on the Flight Engineer/Second Officers panel or APU EXTERNAL CONTROL panel.

R (6) Malfunctioning of any APU component in a failure mode that produces a fault protection circuit trip.

R (7) Failure to achieve a successful start within the time limit imposed by the ECU start/stop timer.

A normal shutdown is initiated by momentarily depressing the STOP switch on the APU CONTROL panel. The shutdown initiated in this manner is triggered by the ECU shutdown circuitry which decelerates the APU to 63 percent Ng idle rpm. After approximately 80-seconds at 63 percent idle rpm, an ECU simulated overspeed N2 signal is generated which shuts down the APU.

The N2 overspeed fault protection circuit is thus checked out with each normal shutdown.

During all shutdowns, operation of the APU is terminated by the ECU which deenergizes the solenoid actuated fuel shutoff and bypass valves and cuts off fuel flow to the engine. Fuel cutoff during emergency shutdowns is rapid enough to prevent any overspeeding of the APU that might be incurred by sudden loss of applied loads.

Completion of the shutdown sequence is indicated when the DOOR IN TRANSIT light indicates closure of the APU
R air vent ejector doors. and air inlet doors. The APU MASTER POWER switch is then actuated to the OFF position to disconnect the battery bus from the APU start circuits. A shutdown using the NORM STOP switch on the external control panel occurs in the same manner. The solenoid held MASTER POWER switch is then deenergized by depressing the panel POWER ON
R switchlight. However, this must not be done until
R sufficient time is allowed for the air vent ejector
R doors to close. During a normal shutdown, the N2

overspeed fault protection circuit is inhibited to prevent tripping of the OVERSPEED N2 fault flag.

When the STOP switch button is depressed, the APU generator drops off the line. The latching voltage that holds APU STOP relay (4961-K1) energized is removed (Ref. Fig. 6) and the DONT LOAD light comes on.

On aircraft 001-014,
the continuous power circuits are switched to the BAT BUS. An interruption of power during the transfer is prevented by the T/R POWER INTERRUPT RELAY.

On aircraft 015-999,
if the APU generator was the only source of T/R power, BATTERY POWER CONTROL relay (energized by T/R power) deenergizes and switches the ECU and continuous power circuits to the BAT BUS. The loss of T/R power is sensed by the T/R POWER INTERRUPT RELAY which prevents an interruption of power by applying battery bus voltage before the BATTERY POWER CONTROL relay relaxes.

With APU STOP relay (4961-K1) deenergized, the following events occur:

(1) A ground is provided at ECU connector J1A, pin 8. An 80-second timer in the ECU is started and an ECU speed control circuit output signal commands the free turbine speed controller to decrease engine speed to 63 percent idle rpm. The engine decelerates to and runs at 63 percent idle speed until the timer runs down. At that time the NfB speed sensor input signal to the ECU is replaced by an internally generated false 112 percent Nf overspeed signal which energizes the ECU K6 fault shutdown relay.

(2) With the K6 relay energized, the following events occur simultaneously:

(a) The ECU start/stop timer is started. (The function of the timer, at this time, is to delay deenergization of the inlet door control relays and closure of the air vent ejector doors until the APU has coasted to a stop.)

R (b) With the APU stop relay deenergized, the Nf overspeed fault flag circuit in the ECU is disarmed. This prevents the false overspeed N2 command signal that is used by the ECU to shutdown the APU from tripping the OVERSPEED N2 fault flag.

(c) The automatic fuel shutoff valve solenoids are deenergized. The fuel shutoff valve closes and the fuel bypass valve opens, shutting off fuel flow to the engine fuel manifold.

(d) When the 40-second timer runs down, the ECU ground holding the inlet door control relays energized is removed and the relays are deenergized.

(3) When APU INLET DOOR NO. 1 relay deenergizes, the following events occur:

(a) The valve open command voltage to the APU secondary emergency fuel shutoff valve is removed. The valve remains open.

R (b) 28V dc continuous power is applied through the relaxed 4911-K4 relay contacts and close limit switch in the vent ejector door actuator to the door-in-transit light circuit. The DOOR IN
R TRANSIT light comes on.

(4) When APU INLET DOOR NO. 2 relay deenergizes the following events occur:

(a) APU BAT BUS power is applied through the relaxed relay contacts to the close coil of the vent ejector door actuator. The actuator begins to drive the doors closed.

(b) 28V dc power is applied through the still energized APU POWER CONTROL relay (4911-K1), the not closed contacts of the air inlet door actuator close limit switch, and the deenergized APU INLET DOOR NO. 2 relay to the door-in-transit light circuit. The DOOR IN TRANSIT light coming on,
R then going off, indicates closure of the air vent
R ejector doors.

(c) The master power latching voltage circuit to the air inlet door control relays (completed through the air inlet door actuator close limit switch) is opened.

(d) On aircraft 001-014, with the APU INLET DOOR RELAY NO. 2 deenergized, a circuit that applies 28V dc continuous power through the BATTERY POWER CONTROL relay (4961-K14) to the RESET coil of T/R POWER CONTROL relay (4961-K3) is armed. This assures that the relay
R will be reset when the next start is initiated.

R (5) When the air vent ejector door actuator reaches the full closed position, one pole of the door closed limit switch is opened, removing power to the close coil of the actuator motor. Another pole of the door close limit switch opens which removes power from the DOOR IN TRANSIT light, and the light goes off.

When the MASTER POWER switch is manually placed to the OFF position (or electrically unlatched by depressing the external control panel POWER ON switchlight) the battery power RCCB remote control circuit is opened and the RCCB is deenergized. If T/R power is applied to the ground service buses, APU POWER TRANSFER relay (2436-K1) deenergizes and removes T/R power from the APU BAT BUS. If battery power is applied to the APU BAT BUS, it is removed.

With the battery power RCCB deenergized, power is removed from the APU elapsed time indicator and ECU and the APU shutdown cycle is completed.

ELAPSED-TIME INDICATOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

Antiseize Thread Compound, ESSO No. 1, or equivalent

Gasket (Ref. Fig. 401)

2. Referenced Procedure

R 49-00-01 Auxiliary Power Unit (APU) - Maintenance Practices

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker APU BAT BUS - CONT PWR.

(2) In aft fuselage, zone 316, open APU compartment access door 319BR.

(3) Disconnect electrical plug from elasped-time indicator (Ref. Fig. 401).

(4) Remove nuts and washers attaching indicator to support bracket.

(5) Remove indicator and discard gasket.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Place gasket over studs on elapsed-time indicator housing (Ref. Fig. 401).

(3) Coat studs with antiseize thread compound and attach indicator to support bracket with washers and nuts. Torque nuts 5 to 15 lb in.

(4) Connect electrical connector to indicator.

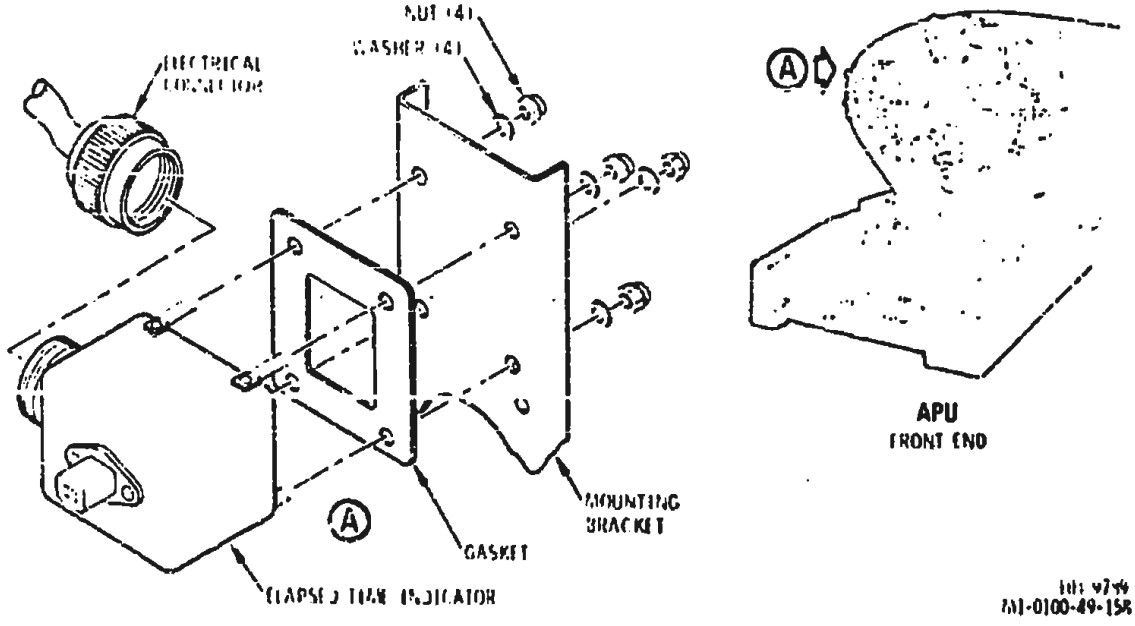
(5) Note digital numbers on indicator.

(6) Remove tag and close circuit breaker opened in Step 3A(1).

R (7) Operate APU (Ref. 49-00-01).

R (8) Shut down APU (Ref. 49-00-01) and check for recording of elapsed time.

(9) Close access door.



Elapsed-time Indicator - Removal and Installation
Figure 401

ENGINE TEMPERATURE (TGT) INDICATING SYSTEM DESCRIPTION AND OPERATION

1. General

An engine temperature indicating system containing four dual element temperature sensing probes and a probe interconnect harness integrates engine compressor inlet, engine compressor outlet, and engine exhaust duct temperatures to produce an engine total temperature input signal to the electronic control unit (ECU). This signal is modified for internal use by the ECU and transmitted to the APU CONTROL panel for an analog display
R of engine temperature on a TGT indicator.

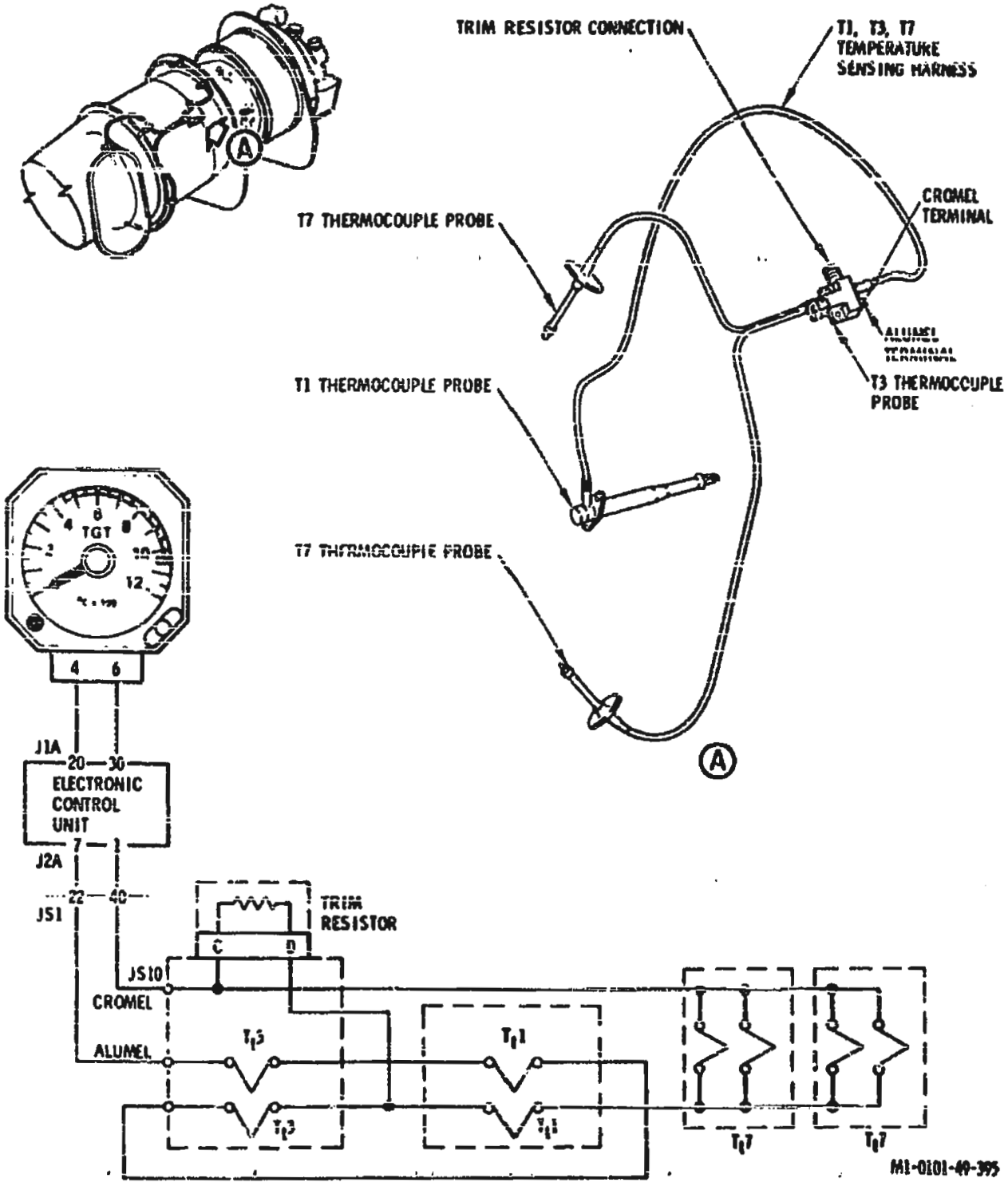
2. T1, T3, T7 Temperature Sensing Harness

A. Description

The engine temperature input signal used by the electronic control unit (ECU) start/stop sequencing, TGT limiting, and overtemp protection shutdown circuitry is generated in an engine temperature sensing harness assembly. The temperature sensing harness consists of four dual element temperature sensing probes and an interconnecting stainless steel braided harness containing chromel and alumel wiring (Ref. Fig. 1). Two of the probes (T7) are mounted on the engine exhaust duct and sense engine exhaust temperature Tt7). A third probe (T1) is inserted into the engine compressor air inlet plenum and senses compressor air inlet temperature (Tt1). The fourth probe (T3) is mounted on the engine case and senses engine compressor outlet air temperature (Tt3). The chromel-alumel wiring interconnecting the probe thermo-couples is terminated at two ECU wiring interface connect terminals on the T3 probe case. Correct interface connection of the wiring from the ECU at this point is assured by the chromel terminal being smaller in diameter than the alumel terminal. The value of a trim resister mounted on the T3 probe case is determined during engine tests and is matched to the engine.

B. Operation

Due to engine combustion chamber design, total turbine inlet temperature (T4) is not measured by thermocouples in the combustion chamber. A simulated signal representing total engine temperature is therefore obtained by sensing Tt1, Tt3, and Tt7 temperatures and is applied as a TGT signal to the ECU. Each thermocouple generates a voltage that is proportional to the temperature sensed by the thermocouple



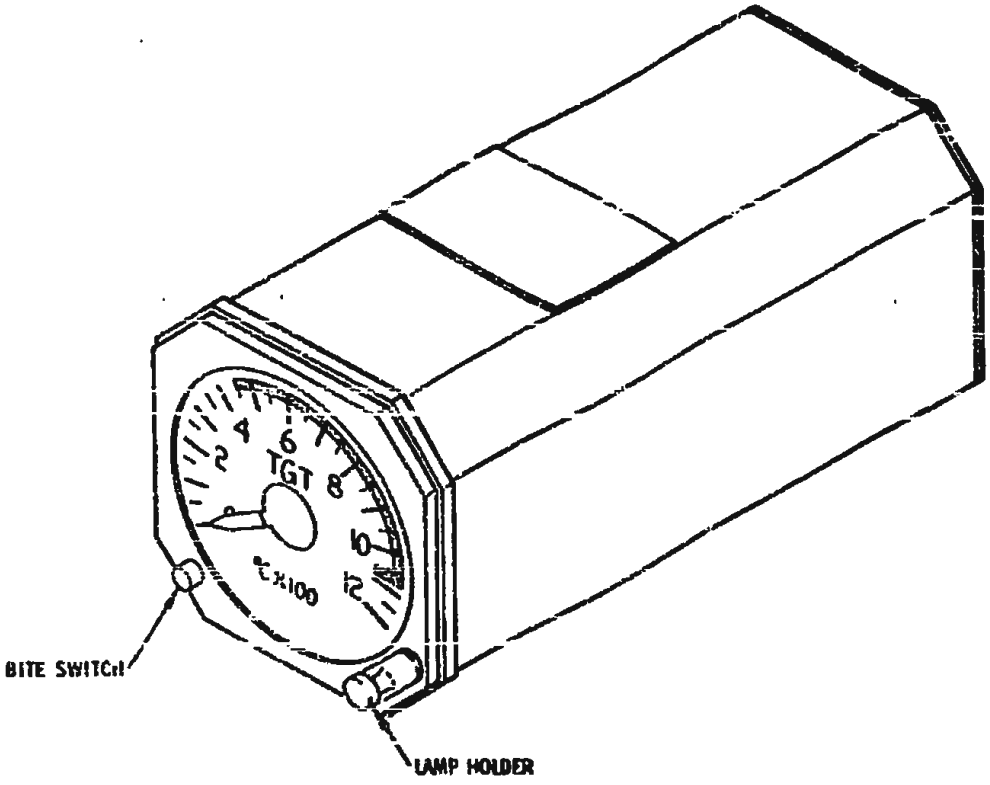
R
R T1, T3, T7 Temperature Sensing Harness
Figure 1

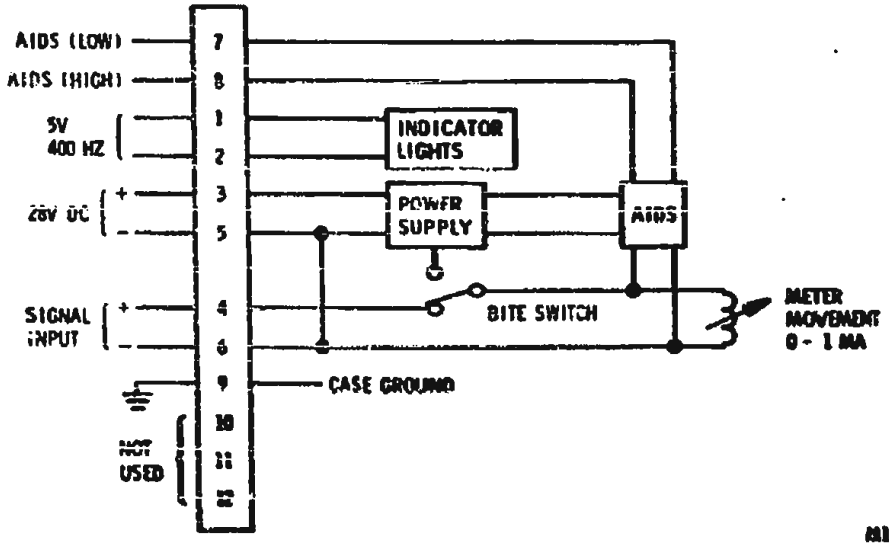
chromel-alumel junction. The two thermocouples in each of the T1 and T3 probes (Ref. Fig. 1) are connected in series with reversed polarities. The four thermocouples in the two
R T7 probes are connected in parallel to provide an average
R exhaust gas temperature (T4). The parallel T7 thermocouple network is wired in series with the T1 and T3 thermocouples to produce an integrated engine temperature signal (Ts)
R equal to Tt7-2(Tt3-Tt1). Since the compressor/turbine
R temperature ratio is subject to turbine blade tip clearances
R and other factors, the exact T4 temperature is determined
R during engine testing and a compensating trim resistor is
R installed. The corrected Ts signal is transmitted to the
R APU electronic controller and used in the ECU control scheduling and APU shutdown protection circuitry.

2. TGT Indicator

A. Description and Operation

A visual analog indication of APU engine total operating temperature is provided by a permanent magnet moving-coil type electrically operated indicator on the APU CONTROL panel (Ref. Fig. 2). The indicator face is graduated from 0 to 1200 and calibrated to indicate engine TGT temperature in degrees C. A green operating band extends circumferentially around the scale from 450 to 1060 degrees C. The 1060-degree mark is indicated by a red radial band. The indicator is integrally lighted by a lamp installed in a removable lamp holder in the lower right corner of the instrument. An operational test of the indicator is performed by depressing a BITE test switch in the lower left corner, and verifying that the pointer moves upscale to the 1060-degree mark.





R
R

TGT Indicator
Figure 2

APU ENGINE TEMPERATURE SENSING HARNESS - REMOVAL AND INSTALLATION

1. Equipment and Materials

Lock-wire, Fed Spec QQ-W-390, 0.032 inch diameter, or equivalent

Insulation Gasket, 2 required (Ref. Fig. 401)

R T3 Thermocouple Probe Gasket (Ref. Fig. 401)

R T7 Thermocouple Probe Gasket, 2 required (Ref. Fig. 401)

2. Referenced Procedure

49-C0-01 Auxiliary Power Plant (APU) - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag BAT PWR circuit breaker (B10).

(2) Open access doors to APU compartment, zone 319.

(3) On left side of APU, separate temperature sensing harness from harness support bracket by removing clamp attach bolt and nut. Remove clamp from harness (Ref. Fig. 401).

(4) Release harness from four support clips located next to the engine front fireseal mount ring and three support
R clips on right side of gas generator case.

R (5) Disconnect JS10 signal wiring harness terminals from T3 thermocouple probe.

(6) Remove Tess trim resistor and retain for installation on new thermocouple probe.

NOTE: The value of trim resistor (Tess) is determined during initial testing of the APU. If replaced, another resistor of identical value must be installed. Refer to engine data plate on the engine accessory case.

R (7) Remove T3 thermocouple probe retaining bolts and carefully withdraw probe out of gas generator case.

R (8) Cut lock-wire and remove both T7 thermocouple probe retaining bolts.

(9) Carefully withdraw both probes out of the exhaust assembly duct. Remove probe mount gaskets.

R (10) On left side of APU, remove T1 thermocouple probe retaining bolts.

(11) Carefully withdraw probe out of the compressor air inlet plenum.

(12) Carefully remove temperature sensing harness from the APU.

R (13) Remove sealing cap, T3 probe gasket, and insulation gaskets from boss on gas generator case.

B. Installation

CAUTION: HANDLE THERMOCOUPLE PROBES WITH CARE AS THE THERMOCOUPLES ARE IN PAIRS AND EASILY BENT. IF THE THERMOCOUPLE PAIRS ARE SHORTED, THE HARNESS WILL TRANSMIT A FALSE TEMPERATURE INDICATION.

(1) Carefully drape temperature sensing harness over gas generator case.

R (2) Place new insulation gaskets, new T3 probe gasket, and
R sealing cap on T3 probe support boss (Ref. Fig. 401).

R (3) Install T3 thermocouple probe. Tighten probe retaining bolts to a torque of 30 (±6) lb in. and install lock-wire.

R (4) Using new probe gaskets, install both T7 thermocouple probes in exhaust duct bosses. Tighten probe retaining bolts to a torque of 30 (±6) lb in. and install lock-wire.

R (5) Install T1 thermocouple probe. Tighten probe retaining bolts to a torque of 30 (±6) lb in.

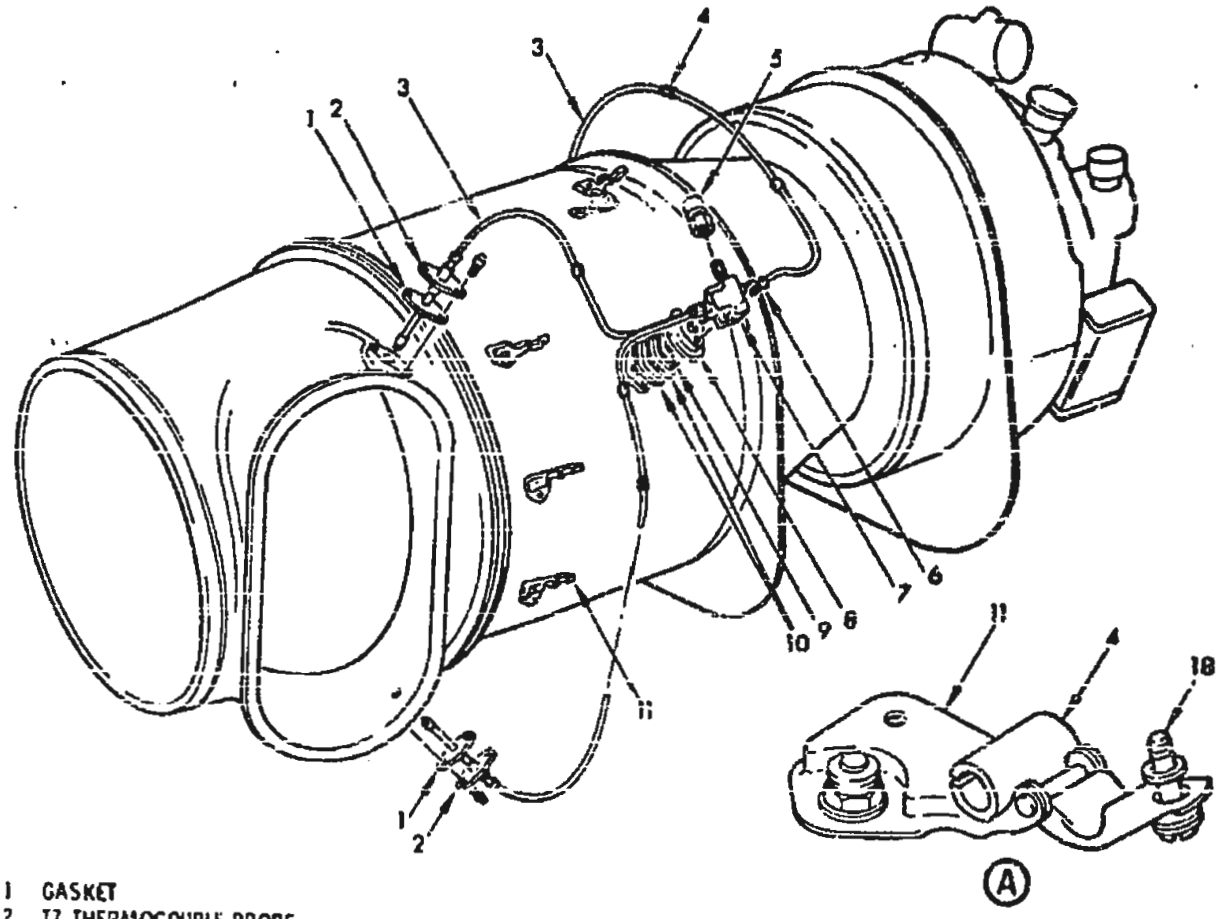
(6) Install Tess trim resistor. Tighten resistor snugly against probe body and add lock-wire.

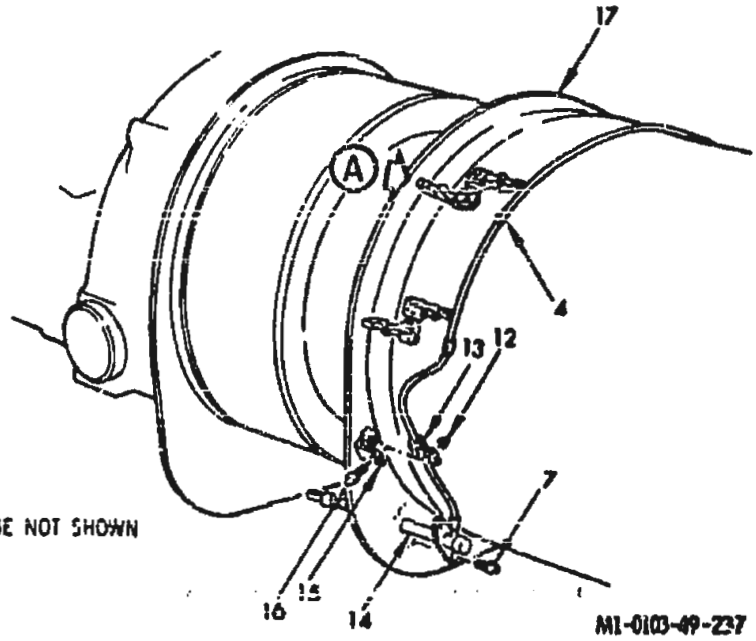
R (7) Slip harness into the grommets cemented to the harness support clips. Secure clips in closed position with captive screws.

R (8) Install harness clamp and secure clamp to support
R bracket next to left forward APU vibration mount.

R (9) Close APU access doors.

R (10) Operate APU to checkout APU temperature indicating
R system (Ref. 49-00-01).





1 GASKET
2 T7 THERMOCOUPLE PROBE
3 TEMPERATURE SENSING HARNESS
4 GROMMET (8) ⚠2
5 TRIM RESISTOR
6 PROBE RETAINING BOLT (TYP)
7 T3 THERMOCOUPLE PROBE ⚠1
8 SEALING CAP
9 GASKET
10 INSULATION WASHER (2)
11 HARNESS CLIP (7)
12 NUT
13 CLAMP
14 T1 THERMOCOUPLE PROBE
15 CLAMP SUPPORT BRACKET
16 SCREW
17 FRONT FIRESEAL MOUNT RING
18 CAPTIVE SCREW

NOTE

⚠1 JSIG SIGNAL WIRING ATTACHMENT TO T3 PROBE NOT SHOWN

⚠2 GROMMET (4) IS CEMENTED TO CLIP (11)

MI-0103-49-237

R APU Engine Temperature Sensing Harness - Removal and Installation
R Figure 401

APU ENGINE TEMPERATURE SENSING HARNESS - ADJUSTMENT AND TEST

1. Equipment and Materials

Test Set, Turbine Temperature Indicating, Barfield Model 2312G-8, or equivalent, or in lieu of test set, the following items:

R NOTE: Model 2312G-8 test set may be procured from BARFIELD
R INSTRUMENT Corp., 4101 N.W. 29th St., Miami, Fla. 33142.

Wheatstone Bridge, or equivalent resistance measuring device
R (0.05 to 5.00 ohm range and accuracy of ±0.5%)

DC Megger (capable of measuring resistance of at least 20,000 ohms), or equivalent

Galvanometer, or equivalent center-zero type meter

100-Watt soldering iron, or equivalent heat source capable of heating thermocouple probes to a minimum temperature of 94 degrees C (200 degrees F)

R Meter, Simpson Model 600, or equivalent

2. Referenced Procedures

49-71-01	APU Temperature Sensing Harness - Removal Installation
R 49-71-01	R APU Temperature Sensing Harness - Inspection and Check

3. Adjustment/Test

A. Resistance Checks

(1) Remove Trim resistor (Ref. 49-71-01).

R (2) Remove thermocouple probes from engine (Ref. 49-71-01).

R CAUTION: HANDLE THERMOCOUPLE PROBES WITH CARE AS THE
R THERMOCOUPLES ARE IN PAIRS AND EASILY BENT.
R IF THE THERMOCOUPLE PAIRS ARE SHORTED, THE
R HARNESS WILL TRANSMIT A FALSE TEMPERATURE
R INDICATION.

R (3) Inspect temperature sensing harness (Ref. 49-71-01).

R (4) Disconnect signal harness (JS10) connectors at T3 thermocouple probe (Ref. 49-71-01).

R (5) Measure the resistance between the chromel and alumel terminals. Resistance must be 3.870 to 4.730 ohms.

R (6) Measure resistance between chromel terminal and pin C
R of trim resistor receptacle. Resistance must be 0.050
R to 0.080 ohms.

R (7) Measure resistance between alumel terminal and pin D at trim resistor receptacle. Resistance must be 1.845 to 2.255 ohms.

R (8) Measure resistance between pins C and D. Resistance must be 2.070 to 2.530 ohms.

B. Insulation Check

Perform insulation check using test set, or alternative equipment, first between the chromel terminal and harness braiding, then between alumel terminal and harness braiding. Minimum insulation resistance must not be less than 20,000 ohms.

C. Probe Functional Test

R (1) Connect positive and negative leads of test set, or alternative equipment, to the chromel and alumel terminals, respectively.

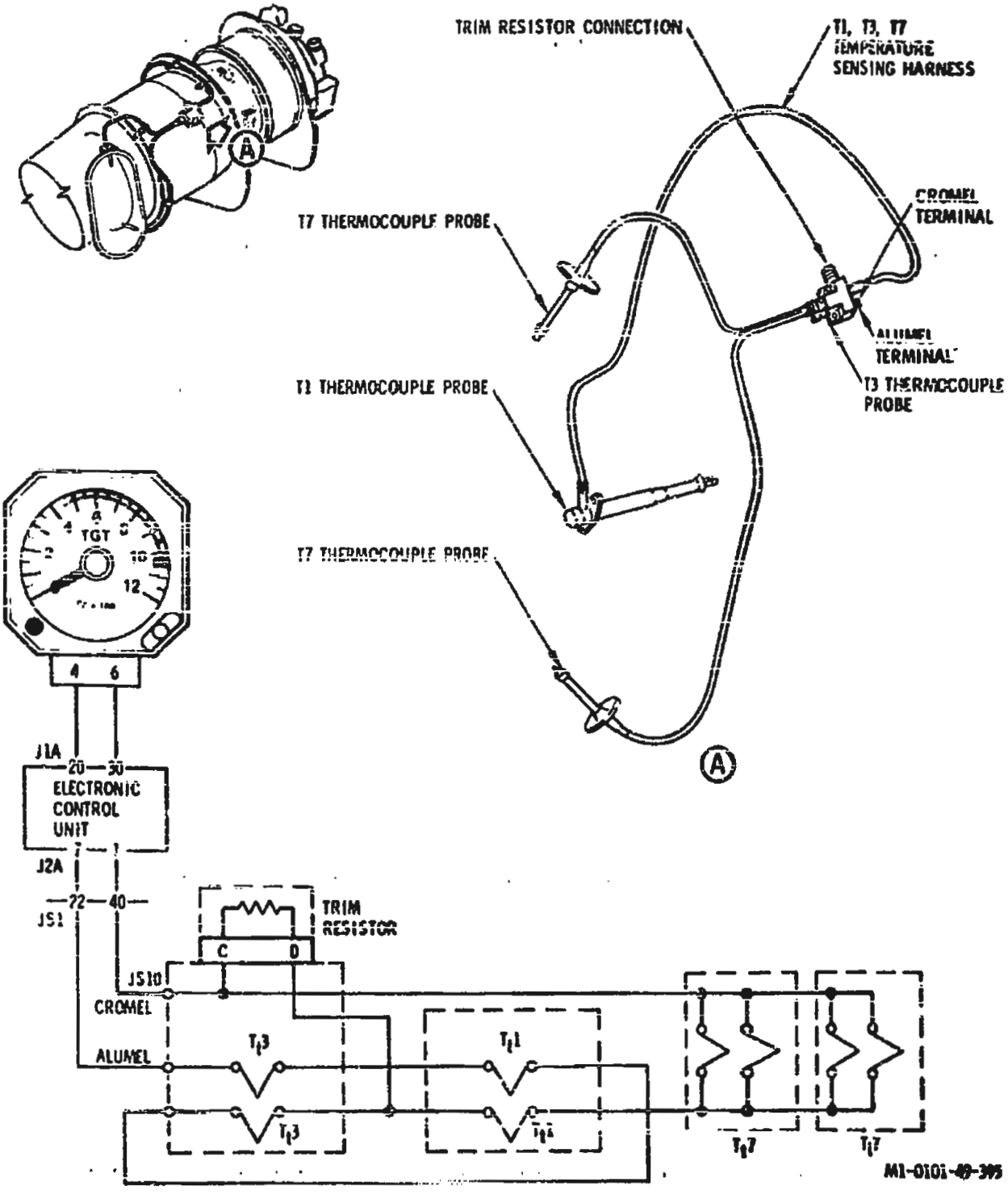
R (2) Apply heat to each of the two T1 probe junctions. Do not exceed 540 degrees C (1000 degrees F). Test Set or alternative meter must indicate negative polarity.

R (3) Repeat preceding check at the two T3 probe junctions and four T7 probe junctions. Test set, or alternative meter must indicate positive polarity.

R (4) Reinstall the thermocouple probes (Ref 49-71-01).

R (5) Reinstall the trim resistor (Ref. 49-71-01).

R (6) Reconnect the signal wiring harness (JS10) connectors to the chromel alumel terminals (Ref. 49-71-01).



R T1, T3, T7 Temperature Sensing Harness
R Figure 501

R EFFECTIVITY: ALL
R
0018

R APU ENGINE TEMPERATURE SENSING HARNESS - INSPECTION AND CHECK

R 1. Referenced Procedures

R 49-71-01 APU Engine Temperature Sensing Harness - Removal
R and Installation

R 49-71-01 APU Engine Temperature Sensing Harness - Adjustment
R and Test

R 2. Inspection/Check

R A. Procedure

R CAUTION: HANDLE THERMOCOUPLE PROBES WITH CARE AS THE
R THERMOCOUPLES ARE IN PAIRS AND EASILY BENT. IF
R THE THERMOCOUPLE PAIRS ARE SHORTED, THE HARNESS
R WILL TRANSMIT A FALSE TEMPERATURE INDICATION.

R (1) Remove thermocouple probes from engine (Ref. 49-71-01).

R (2) Inspect the ceramic insulation of the thermocouples of
R each probe for signs of oil contamination. Should this
R be evident, reject harness.

R (3) Inspect each probe for signs of pitting, erosion,
R cracks or visible folds in the probe sheaths. If
R cracked, bent or corroded probes are found, reject
R harness.

R (4) Check for clearance between thermocouples on each probe
R to ensure that they are not touching. Carefully ease
R thermocouples apart if necessary.

R (5) Inspect cable braiding for dents, cuts, abrasions,
R corrosion and looseness of attachment to probes.
R Should any of these be evident, reject harness.

R (6) Perform harness adjustment and test procedures (Ref.
R 49-71-01).

TURBINE GAS TEMPERATURE (TGT) INDICATOR - REMOVAL AND INSTALLATION

1. Referenced Procedure

   49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

2. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers (B9 through B-14).

      NOTE: The TGT indicator is secured by a cam-operated support clamp which is loosened when two clamp tension screws are backed out.

      (2) Loosen support clamp tension screws (Ref. Fig. 401).

      (3) Withdraw TGT indicator out of panel and disconnect electrical connector.

      (4) Remove indicator.

   B. Installation

      (1) Verify that circuit breakers opened in Step 2A(1) are opened and tagged.

      (2) Connect electrical harness connector to TGT indicator.

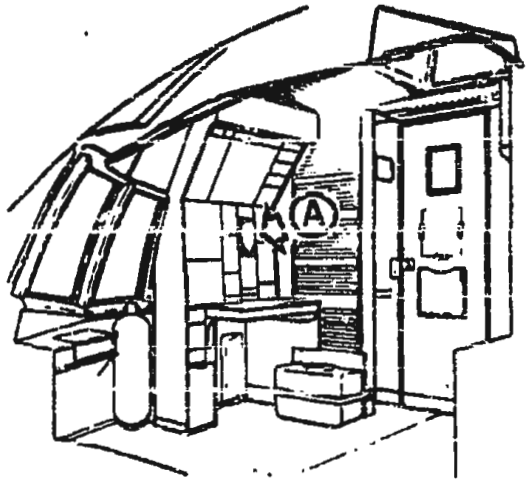
      (3) Insert TGT indicator into support clamp (Ref. Fig. 401).

      (4) Tighten support clamp tension screws 5 to 8 lb in.

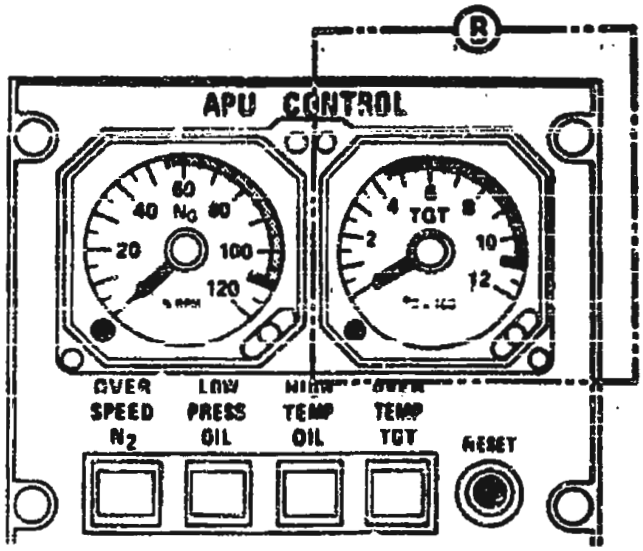
      (5) Remove tag and close circuit breaker opened in Step 2A(1).

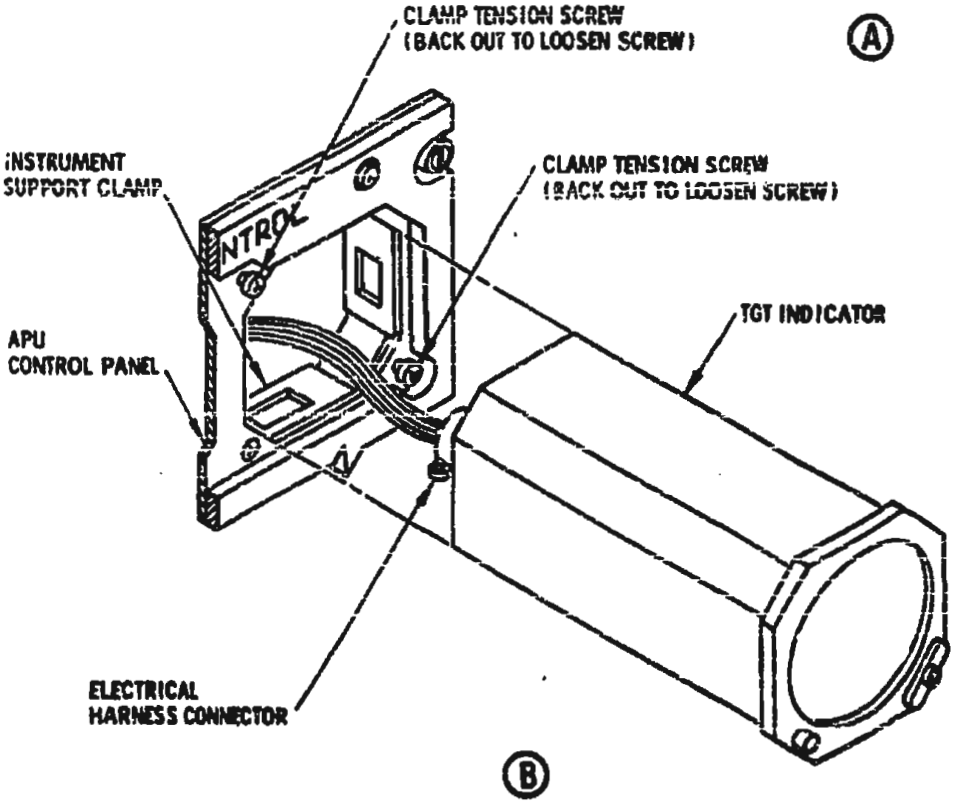
      (6) R Apply APU master power and depress indicator BITE button. Indicator pointer must drive upscale to 1060°C reading and return to 0 mark when BITE button is released.

      (7) Operate APU to verify indicator operation (Ref. 49-00-00).



FLIGHT ENGINEER/SECOND OFFICERS STATION
ZONE 215





M1-0102-49-016

R Turbine Gas Temperature (TGT) Indicator - Removal and Installation
R Figure 401

Ng INDICATING SYSTEM - DESCRIPTION AND OPERATION

1. General

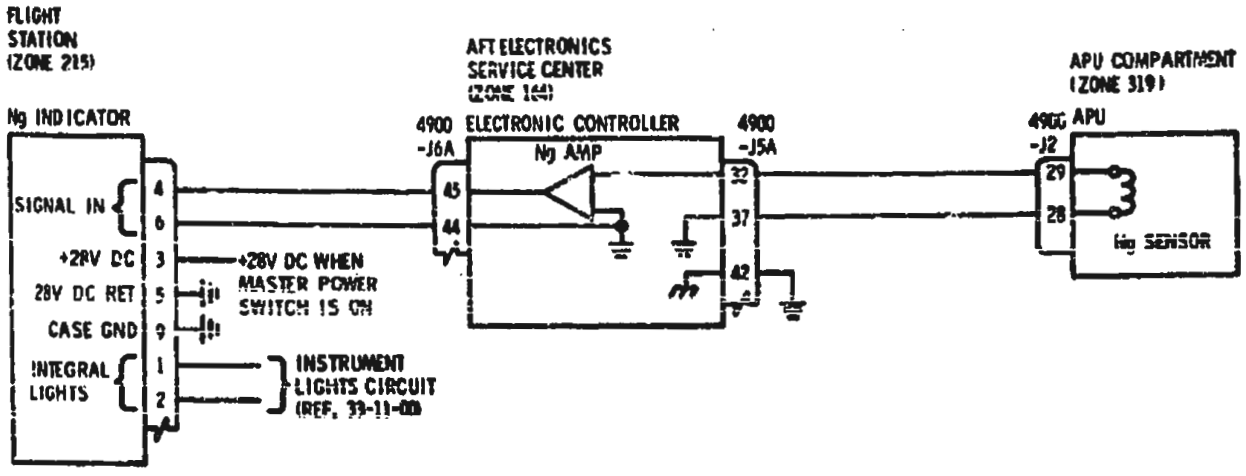
The Ng indicator on the APU CONTROL panel, zone 215, displays
R the gas generator (Ng) RPM.

The Ng indication system consists of a tachometer mounted on the APU engine accessory case, an indicator mounted on the APU CONTROL panel, and the interconnecting wiring. The wiring (Ref. Fig. 1) goes through the APU electronic controller where the tachometer signal is processed and sampled for control purposes. An output from the controller goes to the indicator where it is converted into a control signal for the indicator movement.

The controller circuit interrupts the indicator signal when power is removed from the controller. Therefore, the RPM indication will drop to zero when the controller power is removed, even if the APU is still turning.

2. Gas Generator Tachometer

A. Description and Operation



MM 5843
EM1-0101-49-056

RPM Indication System
Figure 1

EFFECTIVITY: ALL

001E

The bearingless gas generator tachometer consists of a housing containing a stator, a magnet, and a coil. The housing is bolted to the engine accessory case. A rotor with an expanding collet is installed in the housing. The collet, which is expanded by tightening a screw, wedges firmly in the square hole in the engine stub shaft. A cover assembly containing the electrical connector and a pickup coil is installed on the housing to complete the tachometer assembly. The tachometer must be disassembled for removal from the engine.

The tachometer generates an output whose frequency is proportional to the gas turbine RPM. The signal, which is fed to the electronic controller, is used to control APU fuel and to drive the Ng indicator.

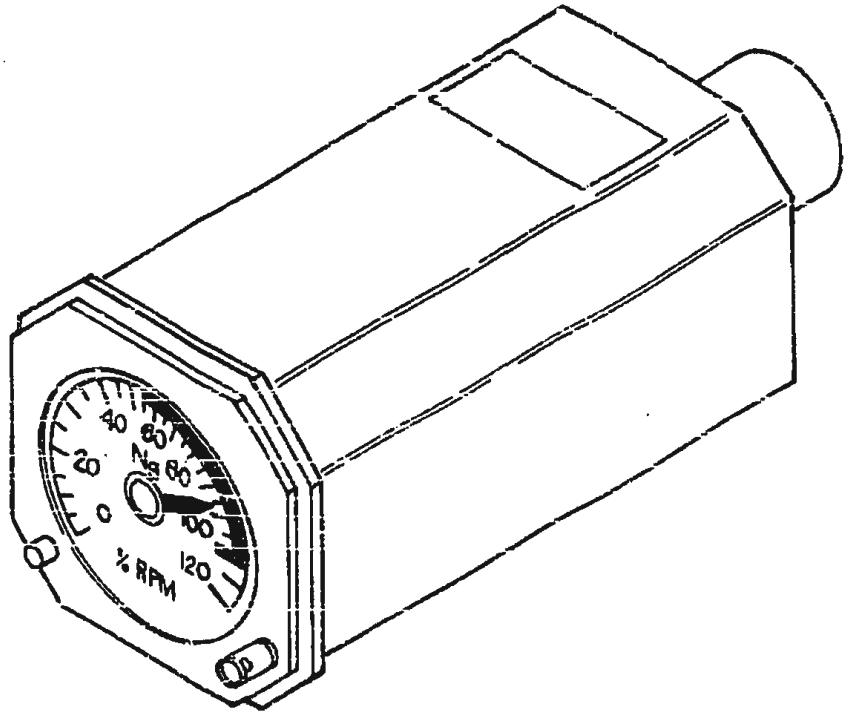
3. Ng Indicator

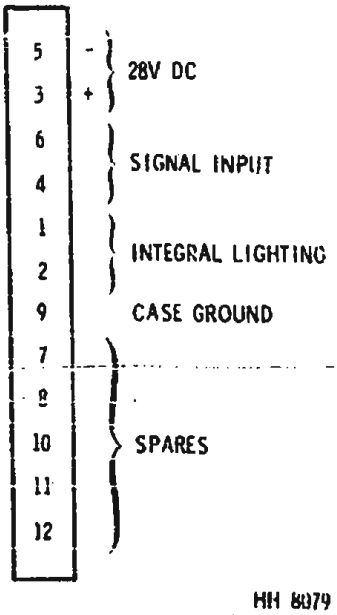
A. Description and Operation

The Ng indicator (Ref. Fig. 2) receives a 5V variable frequency square wave signal from the APU electronic controller and converts it into a visual indication of percentage RPM. The indicator face is graduated in 5-percent steps and has a green band (normal operation) from the 55-percent to the 101.6-percent markings. The 101.6-percent mark is accented by a red radial warning mark. An APU gas generator speed of 37,500 RPM is indicated as 100 percent.

A built-in-test-equipment (BITE) switch is installed in the lower left corner of the instrument. Pressing this switch causes the indicator to move to the 100-percent mark if the instrument is operating properly.

A plug-in lamp holder is located in the lower right corner of the instrument. This arrangement permits lamp replacement without removing the instrument from the panel.





HH 8079
M1-0201-49-128

CR
CR

Ng RPM Indicator
Figure 2

EFFECTIVITY: ALL

001

GAS GENERATOR TACHOMETER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Gasket, MS9134-01, or equivalent

Jig, Rotor Air Gap Setting - Plessey Aerospace P/N 558/1/02787/001, or equivalent

Jig, Rotor Air Gap Setting - Plessey Aerospace P/N 558/1/02787, or equivalent (HAM STD P/N GS 14968-1 is an approved equivalent for P/N 558/1/02787)

Lock-wire, Fed Spec QQ-W-390, 0.020-inch diameter, or equivalent

2. Referenced Procedures

R 6-40-00 Exterior Access Doors and Panels

49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

3. Removal/Installation

NOTE: Procedural steps for removal and installation of gas generator tachometer P/N 764879-1 (Plessey R1110) are included in Steps 3D and 3E. This unit is factory/overhaul shop adjusted and assembled and does not require the rotor to magnet air gap adjustment that is necessary when installing the earlier P/N 738063-1, -2 units which it replaces.

A. Removal (Gas Generator Tachometer P/N 738063-1, -2)

R (1) On Flight Engineer/Second Officers (FE/SO) aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers (B9) through (B16).

(2) Affix MAINTENANCE IN PROGRESS tag to APU CONTROL panel.

(3) Gain access to the APU gas generator tachometer by opening access doors 319AL and 319BR.

(4) Disconnect signal harness connector J38 (Ref. Fig. 401).

(5) Remove tachometer coil housing attach screws and separate coil housing and instruction plate from magnet housing (Ref. Fig. 401).

(6) Bend back tab washer tangs (on P/N 738063-1 tachometer) or open up pressed in surfaces of retainer cup (on P/N 738063-2 tachometers).

NOTE: In following step, loosen rotor assembly shaft bolt only the amount necessary to permit withdrawal of rotor assembly from its installed position.

(7) Loosen rotor assembly shaft bolt and remove rotor assembly.

NOTE: On the aircraft replacement of a faulty coil housing or rotor assembly does not necessarily require replacement of the magnet housing. If serviceable, the magnet housing may be left in place and a faulty tachometer restored to operation by the installation of new rotor assembly and/or coil housing.

(8) If magnet housing is to be replaced, remove the four housing attach screws and washers and remove the housing from its installed position.

R B. Installation (Magnet Housing, Gas Generator Tachometer P/N
R 738063-1, -2)

(1) Separate coil assembly from magnet housing by removing the coil housing attach screws and washers (Ref. Fig. 401).

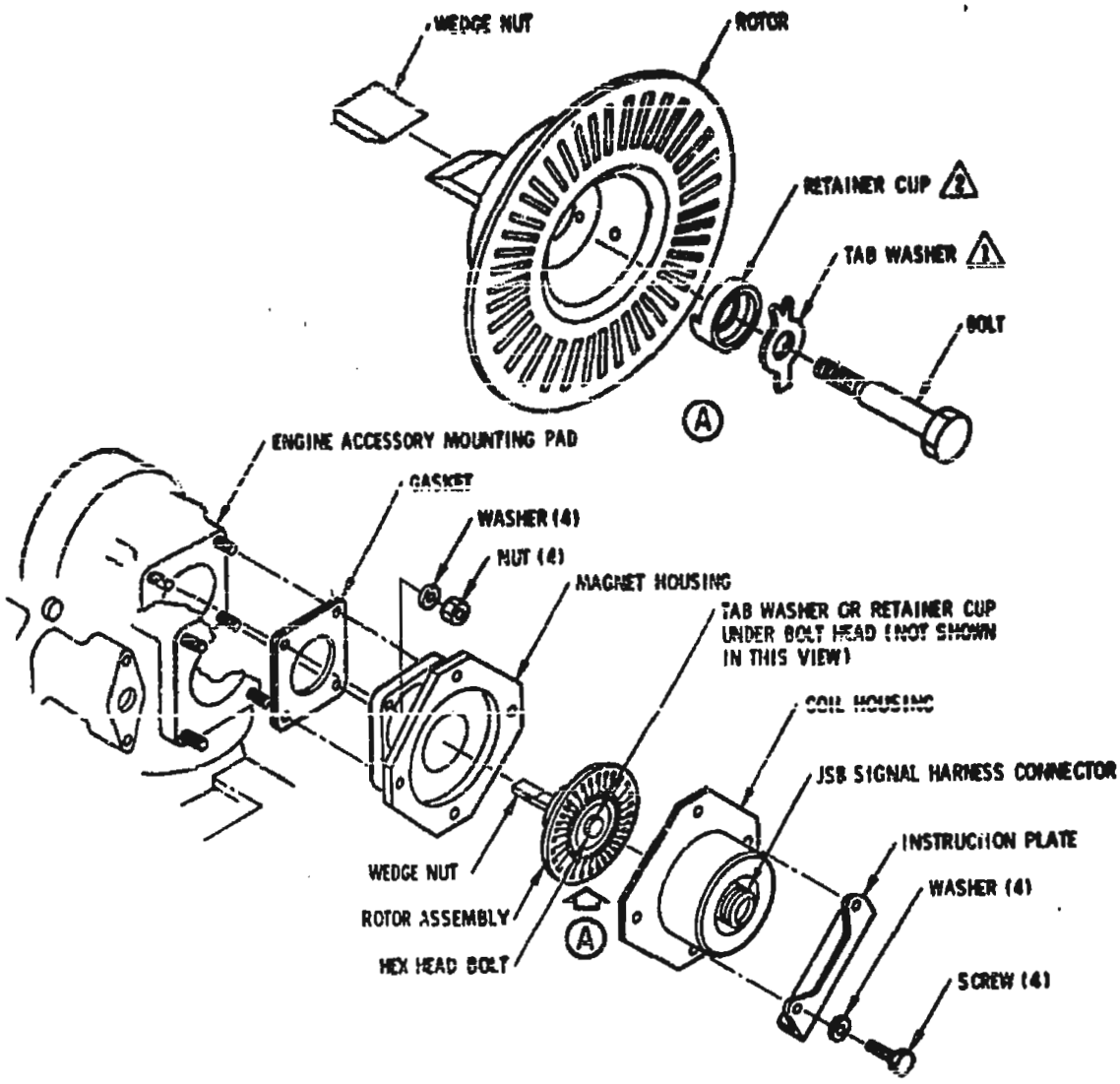
(2) Remove the rotor assembly from the magnet housing.

R (3) Position a new P/N MS9134-01 gasket against the engine accessory case tachometer mounting pad and place magnet housing in its installed position on the mounting pad studs.

(4) Secure the magnet housing to the accessory case using four flat washers and self-locking nuts. Note the torque required to thread the nuts onto the studs. Tighten the nuts to torque value 65 to 85 lb inches higher than the nut installation torque.

R C. Installation (Rotor Assembly, Gas Generator Tachometer P/N
R 738063-1, -2)

NOTE: If only the rotor assembly is being replaced, verify that a new tab washer, or serviceable retaining cup (if applicable) is installed under the rotor shaft bolt head. If necessary, dissassemble the rotor assembly and replace this part, making sure that the



NOTE

(1) INSTALLED ON ROTOR ASSEMBLIES IN HS P/N 738063-1 TACHOMETERS

(2) INSTALLED ON ROTOR ASSEMBLIES IN P/N 738063-2 TACHOMETERS AND HS P/N 738063-1 TACHOMETERS MODIFIED TO -2 CONFIGURATION BY PLESSEY SB 5Y49-7-471

MI-0100-49-470

Gas Generator Tachometer - Removal and Installation
Figure 401

locking tang is engaged to its mating hole in the base of the rotor disc supporting cup.

(1) If rotor assembly being installed is one applicable to an HS 738063-2 (or later dash number) tachometer, identified by fiberglass discs bonded to both faces of the metal rotor disc, attach the rotor assembly to a Plessey P/N 558/1/02787/001 rotor air gap jig (Ref. Fig. 402, Sheet 1). If the rotor assembly is one not reinforced by fiberglass discs (HS738063-1 tachometer) attach the rotor assembly to a P/N 558/1/02787 (unmodified) rotor air gap jig (Ref. Fig. 402 Sheet 1), or to an alternate P/N HS GS14968-1 jig (Ref. Fig. 402 Sheet 2). Be certain that the hex headed jig shaft is engaged to the rotor shaft bolt head when using a Plessey jig.

(2) Lightly lubricate the square tachometer drive shaft (and wedge nut surface) with APU engine oil.

(3) With the rotor assembly wedge nut loosened, and the rotor disc held against the jig, insert the rotor assembly into the magnet housing until the jig is seated against the housing. Secure the jig to the housing using the two captive screws in the jig or, if an HS GS14986-1 jig is being used, two number 6-32 UNC-2A screws.

(4) Tighten the rotor shaft (by rotating the hex headed jig shaft) to a torque of 9 to 12 lb inch.

(5) Remove the rotor air gap jig.

(6) Safety the rotor shaft bolt by bending the tab washer tangs against the flat part of the rotor shaft bolt head. If a retaining cup is installed squeeze the sides of the cup against the bolt head.

(7) Position coil housing on magnet housing with No. 1 connector pin facing upwards. Install the housing attach screws with the instruction plate secured by the screws located at the 3 o-clock and 6 o-clock screw positions. Tighten screws to a torque of 10 to 15 lb inches and install lock-wire between screw heads.

CR (8) Install signal harness connector JS8.

(9) On FE/SO aft circuit breakers panel CB3 zone 215, remove tags and close circuit breakers (B9) through (B16).

(10) Remove MAINTENANCE IN PROGRESS tag at APU CONTROL panel.

(11) Operate APU and observe Ng indicator to check operation of tachometer (Ref. 49-00-01).

(12) If magnet housing was replaced, check mounting pad interface for oil leaks.

(13) Close APU compartment access doors 319AL and 319BR (Ref. 6-40-00).

D. Removal (Gas Generator Tachometer P/N 764879-1)

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers (B9) through (B16).

(2) Affix MAINTENANCE IN PROGRESS tag to APU CONTROL panel.

(3) Gain access to the APU gas generator tachometer by opening access doors 319AL and 319BR.

(4) Disconnect signal harness connector JS8.

(5) Remove tachometer support washers and nuts and separate tachometer from engine accessory case (Ref. Fig. 403).

E. Installation (Gas Generator Tachometer P/N 764879-1)

(1) Verify that circuit breakers opened in Step 4D(1) are open and tagged.

(2) Apply thin film of petrolatum graphite to threaded portion of tachometer mount pad studs.

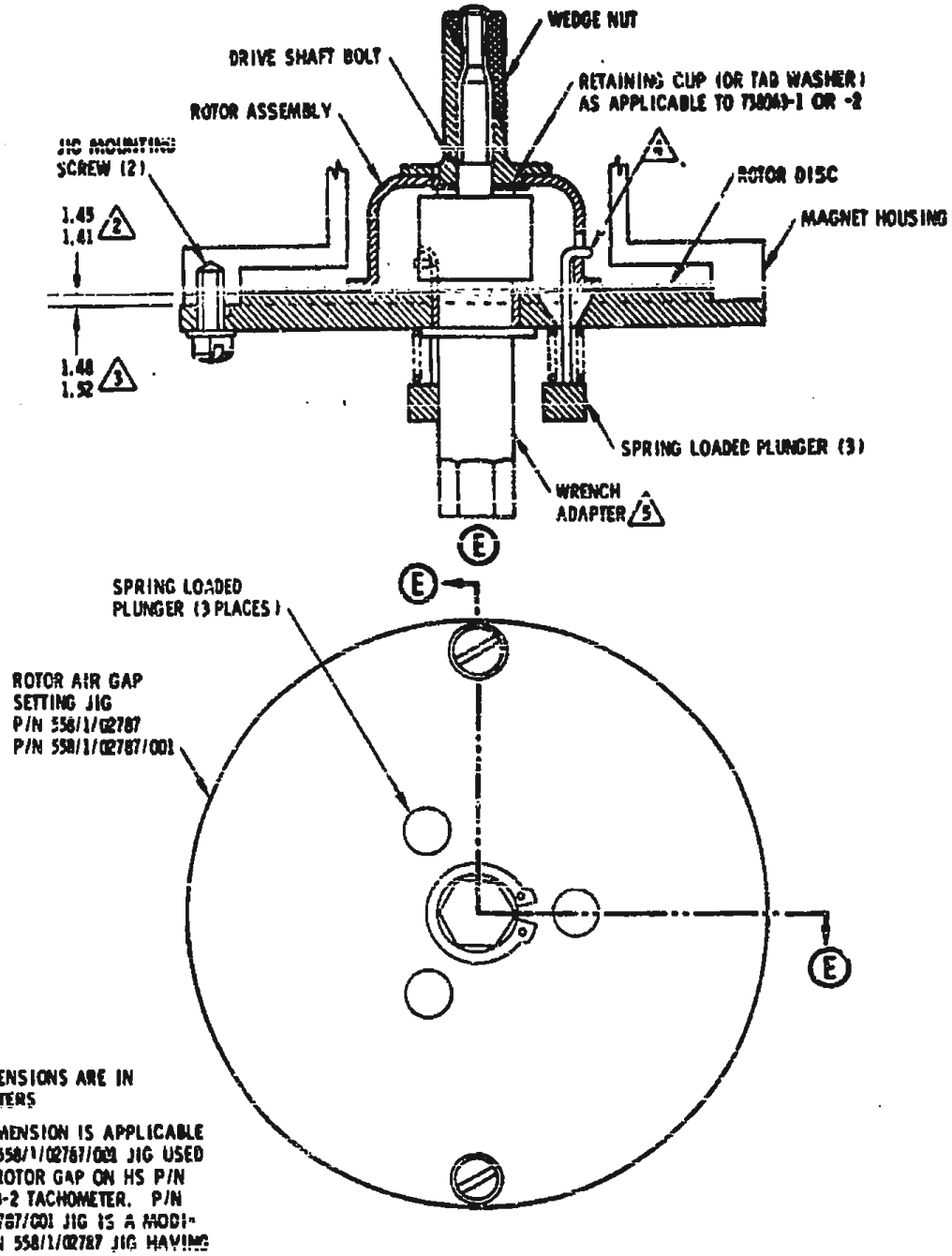
(3) Position new MS9134-01 gasket on mount pad studs and place tachometer on studs.

(4) Install tachometer attach washers and nuts. Tighten nuts to a torque of 65 to 85 lb-in higher than acceptable nut installation torque of 3.5 to 30 lb-in.

(5) Attach electrical harness connector JS8 and secure connector with 0.020-in. lock-wire.

(6) Close APU access doors 319AL and 319BR.

(7) Remove tags and close circuit breakers opened in Step 4D(1).



NOTE

1 ALL DIMENSIONS ARE IN MILLIMETERS

2 THIS DIMENSION IS APPLICABLE TO P/N 558/1/02787/001 JIG USED TO SET ROTOR GAP ON HS P/N GS738063-2 TACHOMETER. P/N 558/1/02787/001 JIG IS A MODIFIED P/N 558/1/02787 JIG HAVING 0.07 MILLIMETERS MACHINED OFF THE JIG SURFACE THAT BEARS AGAINST THE ROTOR ASSEMBLY DISC (REF. PLESSEY SB SY49-5-9121)

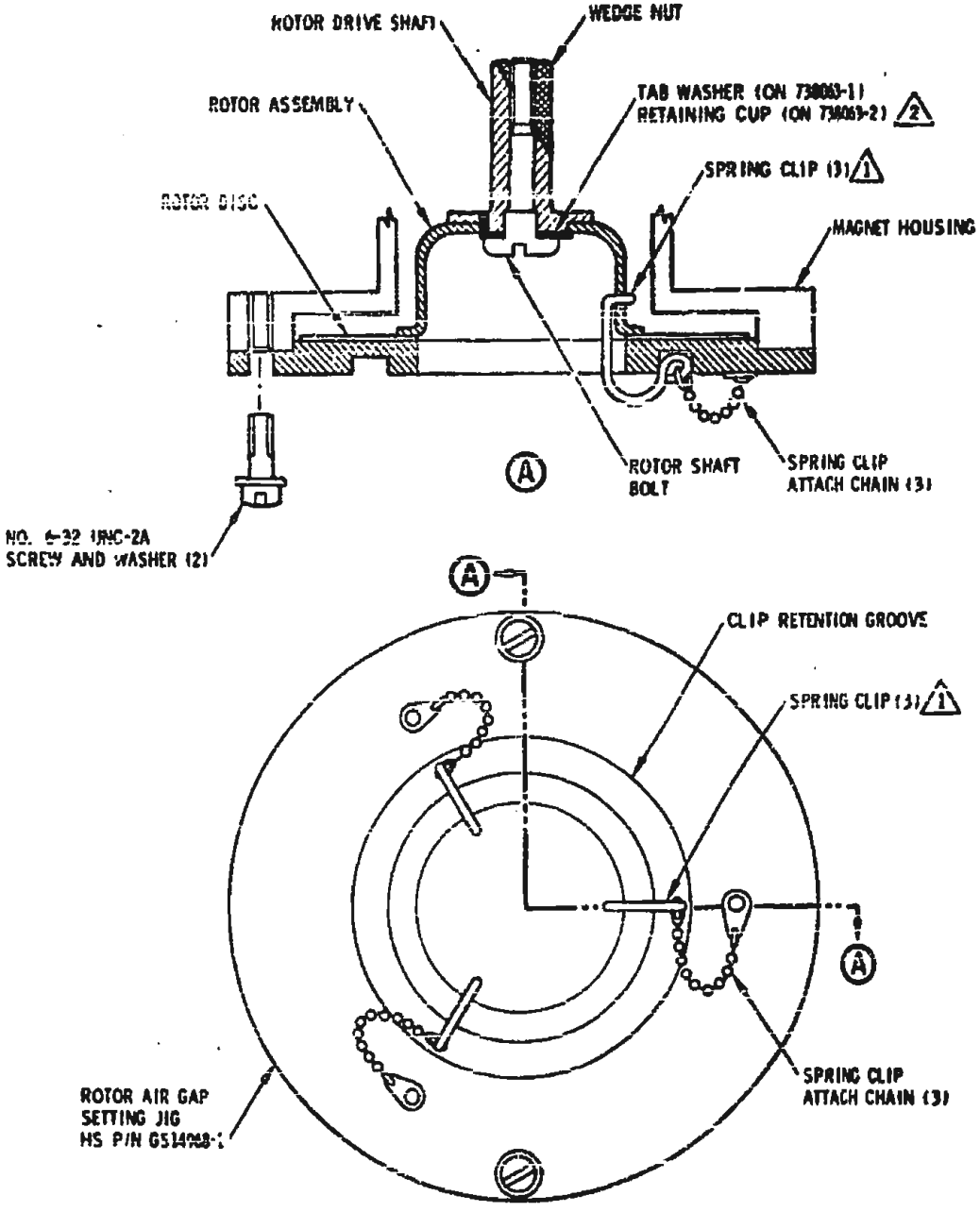
3 THIS DIMENSION IS APPLICABLE TO P/N 558/1/02787 JIG USED TO SET ROTOR GAP ON HS P/N 738063-1 TACHOMETER

4 HOOKS ON SPRING LOADED PLUNGERS RETAIN ROTOR ASSEMBLY DISC AGAINST FACE OF JIG

5 ROTATE WRENCH ADAPTER TO LOOSEN AND TIGHTEN WEDGE NUT

M1-0100-49-471

Rotor Air Gap Setting Jig
Figure 402 (Sheet 1)



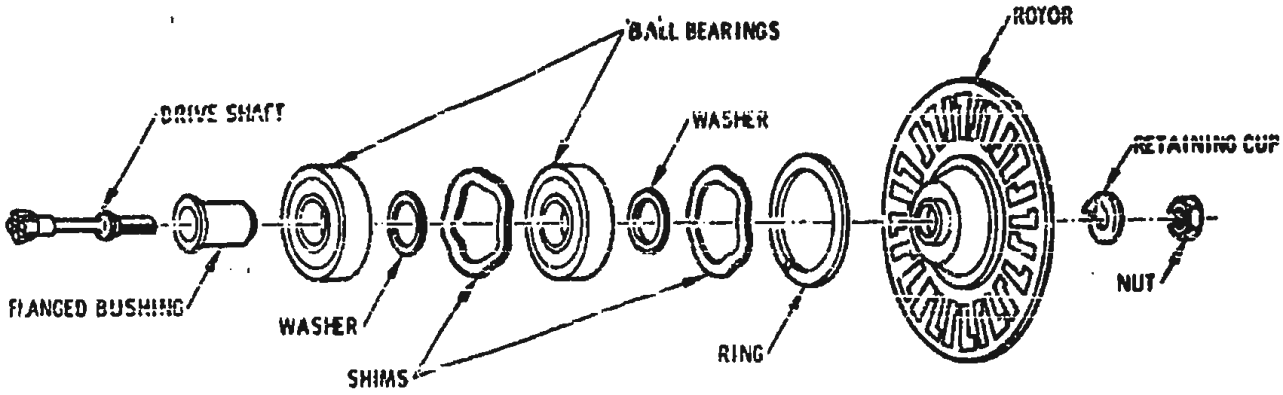
NOTE

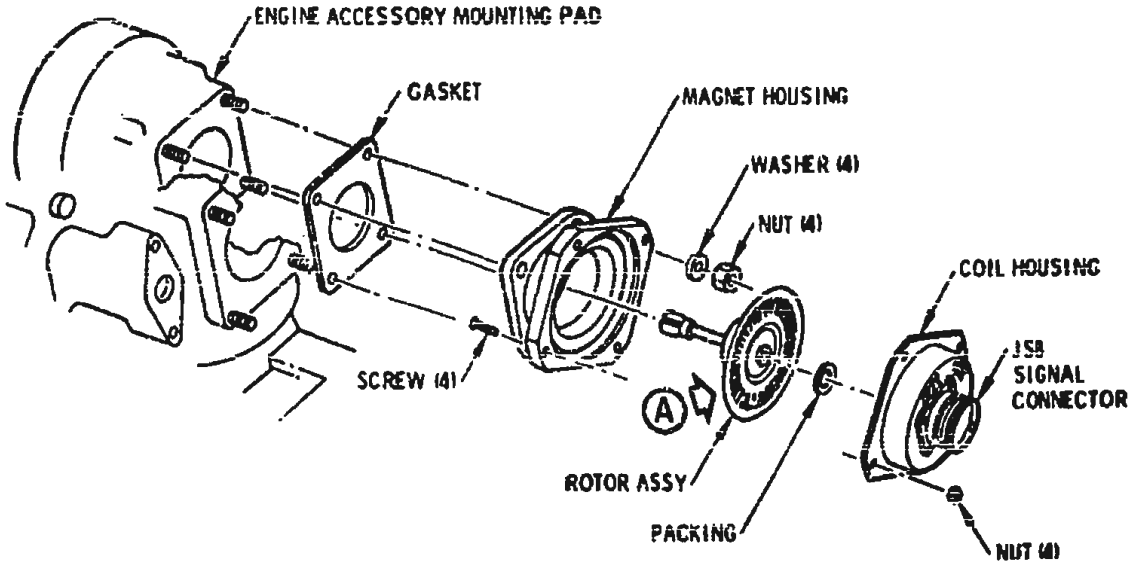
1. SPRING CLIPS HOLD ROTOR DISC AGAINST FACE OF JIG WHILE ROTOR SHAFT BOLT IS TIGHTENED
2. ROTOR SHAFT BOLT IS SAFETIED BY BENDING UP TANGS OF TAB WASHER OR SQUEEZING CUP WASHER AGAINST FLAT SURFACES OF ROTOR SHAFT BOLT HEAD

M1-0100-49-072

Rotor Air Gap Setting Jig
Figure 402 (Sheet 2)

(8) Operate APU to functionally check tachometer. Operation is ok if APU lights off and accelerates normally to stabilized operating speed (Ref. 49-00-01).





NOTE

P/N 764879-1 TACHOMETER DOES NOT REQUIRE ROTOR TO MAGNET AIR GAP ADJUSTMENT.

REPLACES EARLIER P/N 738063-1, TACHOMETERS.

FA1-0000-49-915

R R Gas Generator Tachometer - Removal and Installation
Figure 403

R R 001B EFFECTIVITY: ALL

Ng INDICATOR - REMOVAL AND INSTALLATION

1. Referenced Procedure

49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

2. Removal/Installation

A. Removal

R (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers (B9 through B14).

R NOTE: The Ng indicator is secured by a cam-operated support clamp which is loosened when two clamp tension screws are backed out.

R (2) Loosen support clamp tension screws (Ref. Fig. 401).

R (3) Withdraw Ng indicator out of panel and disconnect electrical connector.

(4) Remove indicator.

B. Installation

R (1) Verify that circuit breakers opened in Step 2A(1) are open and tagged.

R (2) Connect electrical harness connector to Ng indicator.

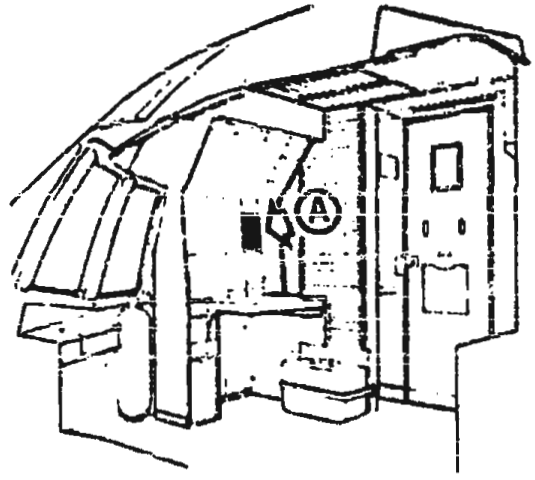
R (3) Insert Ng indicator into support clamp (Ref. Fig. 401).

R (4) Tighten support clamp tension screws 5 to 8 lb in.

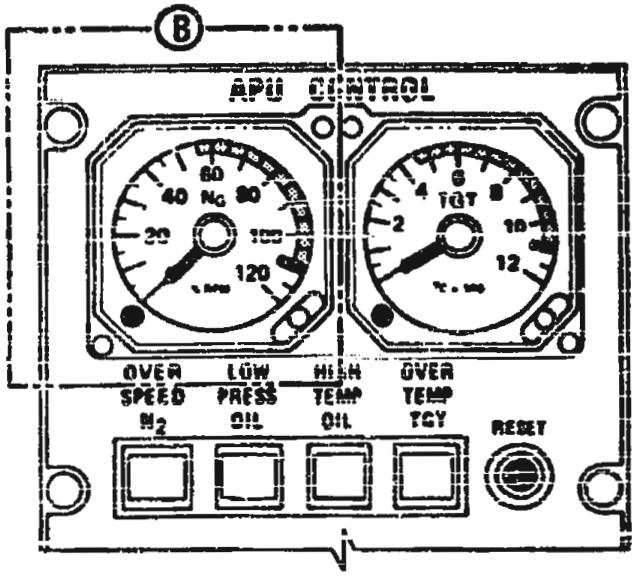
R (5) Remove tag and close circuit breakers opened in Step 2A(1).

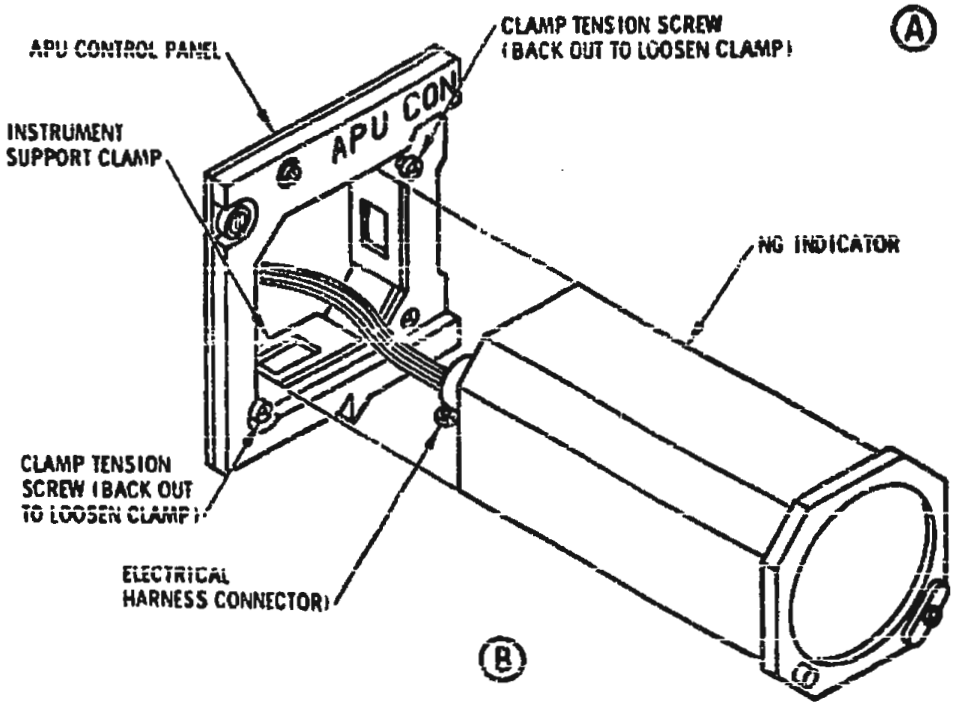
R (6) Apply APU master power and depress indicator BITE button. Indicator pointer must drive upscale to the 100% Ng mark and return to zero when the BITE button is released.

R (7) Operate APU to verify indicator operation (Ref. 49-00-01).



FLIGHT ENGINEER/SECOND OFFICERS STATION
ZONE 215




APU CONTROL PANEL
CLAMP TENSION SCREW (BACK OUT TO LOOSEN CLAMP)
INSTRUMENT SUPPORT CLAMP
NG INDICATOR
CLAMP TENSION SCREW (BACK OUT TO LOOSEN CLAMP)
ELECTRICAL HARNESS CONNECTOR)
B

M1-0100-49-510

R Ng Indicator - Removal and Installation
R Figure 401

EFFECTIVITY: ALL

R N_2 OVERSPEED FAULT INDICATOR FLAG - MAINTENANCE PRACTICES

R 1. General

R This procedure provides information to verify the N_2 overspeed
R auto shutdown function is operational.

R 2. Referenced Procedures

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

R 3. N_2 Overspeed Auto Shutdown Verification

R A. Start the APU and allow it to stabilize (Ref. MM 49-00-01).

R B. Perform a normal shutdown.

R NOTE: A normal APU shutdown is accomplished by
R introduction of a false N_2 overspeed
R signal. If shutdown occurs, the N_2
R overspeed auto shutdown function is
R operational.

EXHAUST SYSTEM - DESCRIPTION AND OPERATION

1. General

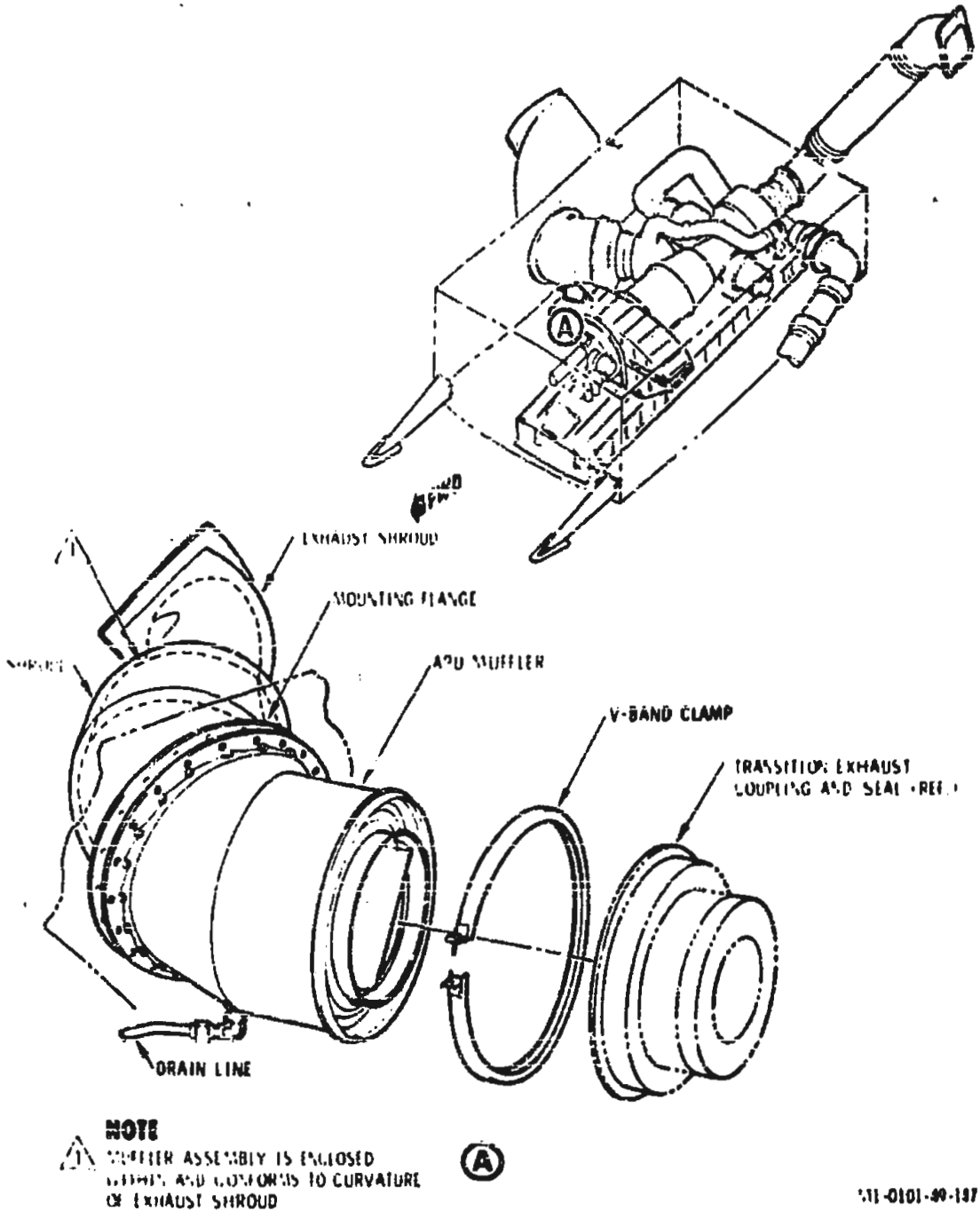
APU engine exhaust gasses are discharged overboard through a muffler which reduces exhaust noise to a more acceptable level. The downstream end of the muffler terminates in an exhaust duct that is directed through an opening in the lower right afterbody section. A shroud surrounds that portion of the muffler assembly between APU compartment wall and afterbody surface. Cooling air from the APU cooling fan is directed through the walls of the muffler and into the annular space between exhaust duct and shroud (Ref. Fig. 1).

2. APU Exhaust Muffler

A. Description

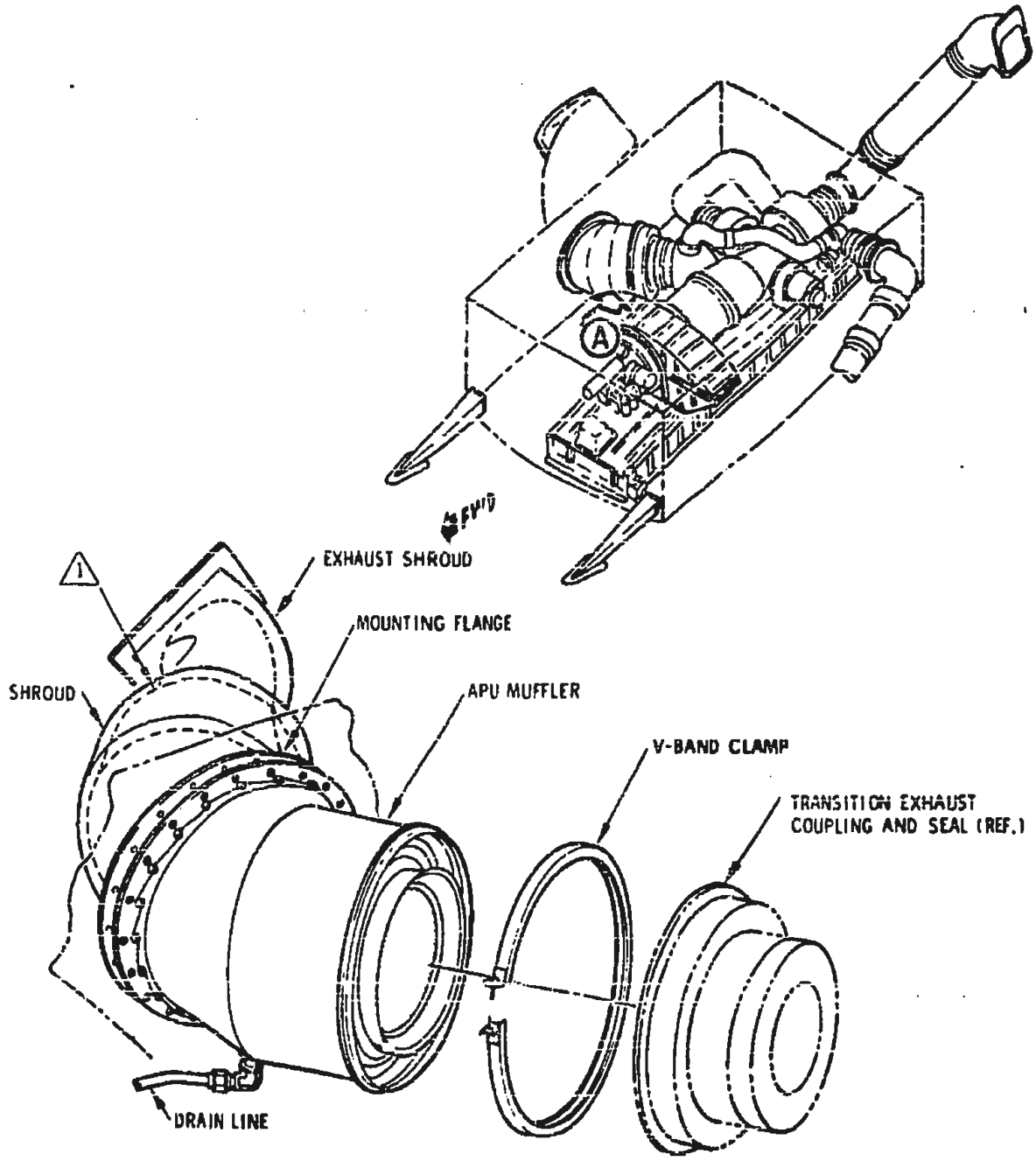
On aircraft 001-031, the exhaust muffler is a double-walled tubular stainless steel assembly attached to a short section of exhaust ducting. On aircraft which have not been modified by SB49-036 (Splitter Core Deletion), a flattened inner core is supported vertically in the center and conforms to the curvature of the assembly. The core and inner wall surfaces are perforated and contain sound attenuating material within the core and between the inner liner and the outer shell of the muffler.

On aircraft 032-999, the exhaust muffler is a double-walled tubular stainless steel assembly attached to a short section of exhaust ducting. Sound attenuating material is contained between the perforated inner liner wall and the outer shell of the muffler assembly. A flange bolted to the outer shell, supports the unit on a circular flange mounted to the sidewall of the APU compartment. The unit is attached to
R the APU transition exhaust coupling by a large V-band clamp. An overboard drain fitting and pipe provide a path for any fluids that might collect within the exhaust assembly.



R
R

APU Muffler
Figure 1



NOTE

1. MUFFLER ASSEMBLY IS ENCLOSED WITHIN AND CONFORMS TO CURVATURE OF EXHAUST SHROUD

M1-0500-49-754

APU Muffler
Figure 1

APU MUFFLER - REMOVAL AND INSTALLATION

R 1. Equipment and Materials

R Preformed Packing (Ref. Fig. 401)

R Gasket (Ref. Fig. 401)

2. Referenced Procedure

R 49-00-01 Auxiliary Power Unit (APU) - Removal and
R Installation

R 3. Removal/Installation

A. Removal

R (1) Remove APU, or lower APU as required to facilitate
R removal of muffler (Ref. 49-00-01).

R (2) Remove exhaust duct extension.

R (3) Remove drain line at bottom of muffler (Ref. Fig. 401).

R (4) Remove APU compartment insulating blanket as required
R for access to the muffler flange attach bolts.

R (5) Remove muffler attach bolts.

R (6) Carefully extract muffler from exhaust shroud and
R remove it from the aircraft.

R (7) Remove elbow fitting and jamnut at drain port.

R B. Installation

R (1) Place gasket (Ref. Fig. 401) on muffler.

R (2) Insert muffler into exhaust shroud (with drain fitting
R pointing down).

R (3) Install muffler flange attach bolts.

R (4) Install insulating blanket.

R (5) Install new packing, elbow fitting, and jamnut at drain
R port.

(6) Install drain line.

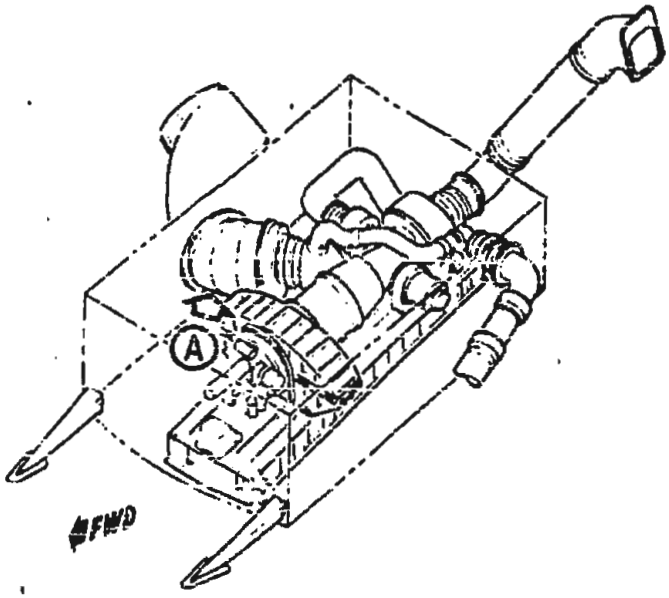
(7) Install exhaust extension as follows:

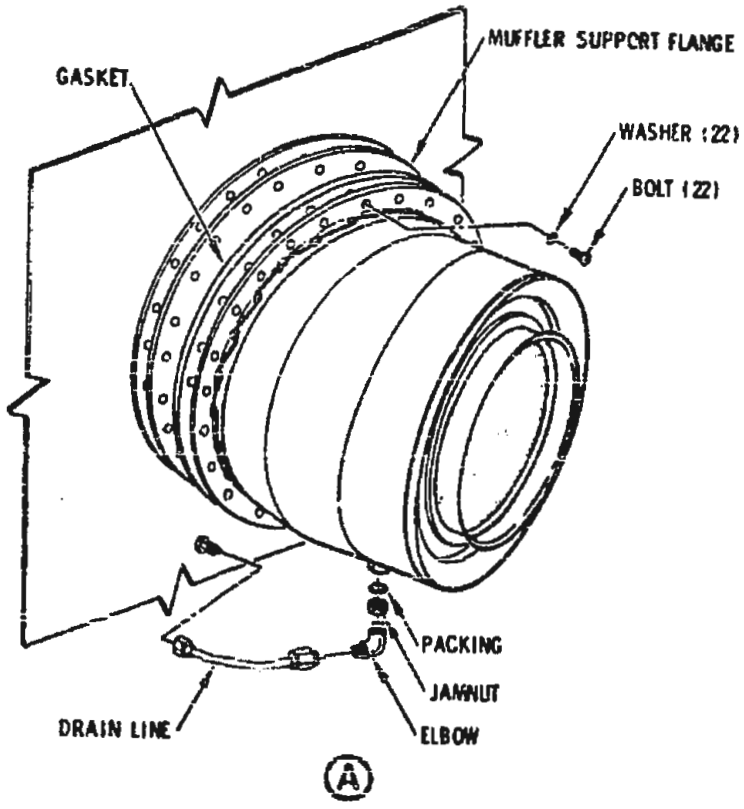
(a) Engage exhaust extension to exhaust duct.

(b) Install bolt, washer, and nut at the 12 o-clock hole position. (Bolts are inserted from inside the exhaust duct.)

(c) Install remaining bolts, washers, and nuts. (Back drill any slightly misaligned holes from inside the exhaust duct.)

(8) Reinstall APU (Ref. 49-00-01).





M1-0600-49-755

R
R

APU Muffler - Removal and Installation
Figure 401

EFFECTIVITY: ALL

001B

TRANSITION EXHAUST HOUSING - REMOVAL AND INSTALLATION

1. Equipment and Materials

Antiseize Thread Compound, ESSO No. 1, or equivalent

2. Referenced Procedures

49-00-01 Auxiliary Power Unit (APU) Assembly - Removal and Installation

49-51-11 Surge Duct - Removal and Installation

3. Removal/Installation

A. Removal

(1) Remove APU (Ref. 49-00-01).

(2) Remove surge duct (Ref. 49-51-11).

(3) Remove air inlet fan-to-exhaust duct by detaching flat band clamps at each end of duct.

(4) Remove band clamp from engine exhaust case-to-transition exhaust housing flange blanket.

(5) Remove machine screws with self-locking nuts and washers attaching transition exhaust housing to engine case.

(6) Place transition exhaust housing on bench and unscrew blanket clamp from muffler side of housing. Slide flexible coupling and seal from end of housing.

(7) Unlace transition exhaust housing blanket and remove blanket.

B. Installation

(1) Position blanket on transition exhaust housing and lace in place.

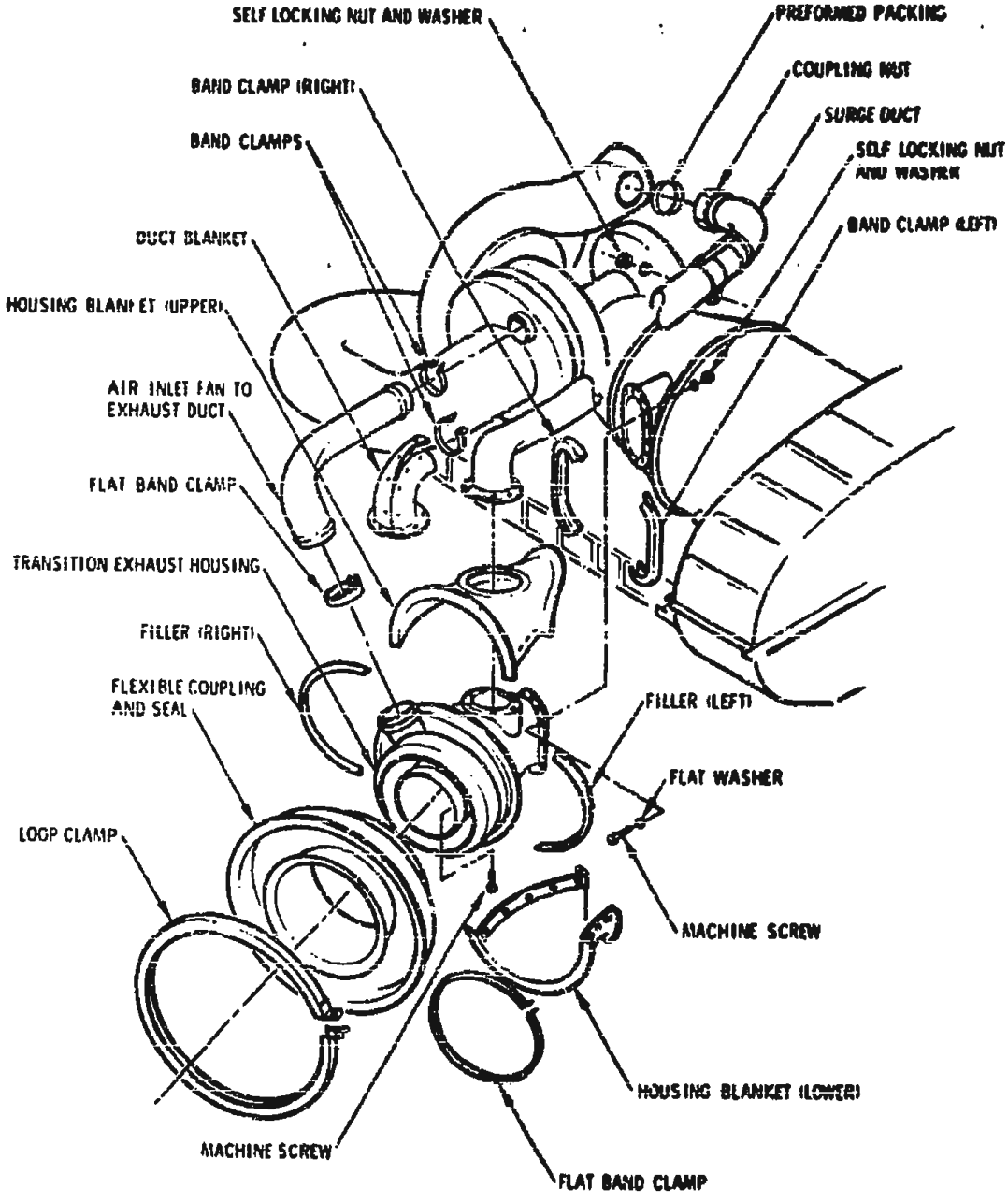
(2) Slide flexible coupling and seal on muffler end of transition exhaust housing. Install blanket clamp on muffler end of housing and tighten nut on clamp.

(3) Position the transition exhaust housing against the engine exhaust case and install machine screws, washers (one on each side of flange) and self-locking nuts. Use antiseize thread lubricant on the screws. Torque screws 35 to 45 lb in.

(4) Install air inlet fan-to-exhaust duct. Secure duct in position with flat band clamps.

(5) Install surge duct (Ref. 49-51-11).

(6) Install APU (Ref. 49-00-01).



R Transition Exhaust Housing - Removal and Installation
R Figure 401

EFFECTIVITY: ALL

001B

R # APU EXHAUST SHROUD - REMOVAL AND INSTALLATION

R 1. Equipment and Materials

R Lock-wire, Fed Spec QQ-W-390, Temp A, 0.020-inch diameter, or
R equivalent

R Control Column Lock P/N BA8U (G/ITEL 27-41-01), or equivalent

R Gasket (2) (Ref. Fig. 401)

R 2. Referenced Procedures

R	6-40-00	Exterior Access Doors and Removal Panels - Description and Operation
R	24-41-00	Exterior Power/Ground Service System - Maintenance Practices
R	29-11-00	Hydraulic Power System - Maintenance Practices
R	49-11-20	Air Vent Ejector Assembly - Removal and Installation
R	49-81-04	APU Exhaust Shroud Seals - Removal and Installation

R 3. Removal/Installation

R A. Removal

R (1) If not required for other maintenance activities, remove electrical power (Ref. 24-41-00).

R (2) Affix MAINTENANCE-IN-PROGRESS tag to APU CONTROL panel.

R (3) At Flight Engineer/Second Officers aft circuit breaker panel, CB3, Zone 215, open and tag APU POWER circuit breakers B9 through B17.

R WARNING: ENSURE ALL FOUR HYDRAULIC SYSTEMS ARE SHUT OFF (Ref. 29-11-00). TAG FLIGHT ENGINEER/SECOND OFFICERS HYDRAULIC SYSTEM PANEL AND HYDRAULIC SERVICE CENTER HYDRAULIC SERVICING PANEL.

R (4) Verify all four hydraulic systems are off (Ref. 29-11-00).

R (5) Affix MAINTENANCE-IN-PROGRESS tags to FE/SO HYDRAULIC
R SYSTEM panel and HYDRAULIC SERVICING PANEL in Hydraulic
R Service Center.

R WARNING: INSTALL CONTROL COLUMN LOCK TO PREVENT MOVEMENT OF
R HORIZONTAL STABILIZER IN THE EVENT OF HYDRAULIC
R SYSTEM PRESSURIZATION.

R (6) Install control column lock.

R (7) Remove access panels 317CB and 317ER (Ref. 6-40-00).

R (8) Open APU compartment access doors 319BR and 319DR (Ref.
R 6-40-00).

R (9) Remove exhaust duct extension (Ref. Fig. 401).

R (10) Remove vent ejector assembly (Ref. 49-11-20).

R (11) Remove APU compartment insulating blanket fasteners as
R required for access to muffler flange attach bolts.

R (12) Remove muffler flange attach bolts.

R (13) Disconnect drain line at bottom of muffler.

R (14) Loosen V-Band clamp attaching APU muffler and
R transition exhaust coupling.

R (15) Slide APU muffler inboard.

R (16) Remove exhaust shroud bolts and remove shroud.

R NOTE: Bolts are different lengths for different
R locations.

R (17) On aircraft with SB49-058,
R perform the following:

R (a) Inspect exhaust duct insulation blanket and
R replace if necessary.

R (b) Remove exhaust shroud insulation.

R B. Installation

R (1) On aircraft with SB49-058,
R perform the following if installation of exhaust duct
R insulation blanket is required:

R (a) Wrap the two halves of insulation blanket around
R exhaust duct (Ref. Fig. 401).

R (b) Temporarily install exhaust duct extension screws through exhaust duct and insulation blankets to maintain hole alignment during installation of insulation blankets and shroud.

R (c) Tie insulation blankets with lock-wire.

R (d) Install band clamp and tighten clamp screw until it bottoms out.

R (2) On aircraft with SB49-058, perform the following,

R (a) Wrap upper and lower insulation blanket around exhaust shroud (Ref. Fig. 401).

R (b) Tie insulation blankets with lock-wire.

R CAUTION: EXHAUST SHROUD BOLTS ARE DIFFERENT LENGTHS. VERIFY BOLTS ARE INSTALLED AT CORRECT LOCATION (REF. FIG. 401).

R (3) Install exhaust shroud with gasket, ensuring exhaust shroud bolts are at correct location and tighten (Ref. Fig. 401).

R (4) Position APU muffler flange against bulkhead, do not install bolts at this time.

R (5) Install exhaust duct extension on exhaust duct with screws, washers and nuts and tighten.

R (6) Install APU muffler with gasket and tighten bolts.

R (7) Install V-Band clamp attaching APU muffler and transition exhaust coupling.

R (8) Connect drain line at bottom of muffler.

R (9) Install APU compartment insulating blanket.

R (10) Install vent ejector assembly (Ref. 49-11-20).

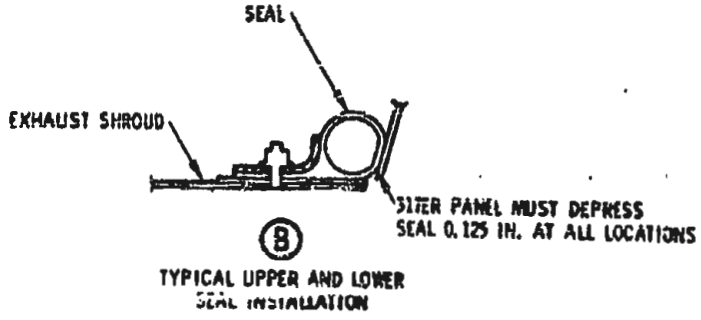
R (11) Close access panel 317ER; verify seals are in full contact with the panel and compressed a minimum of 0.125-inch (Ref. Fig. 401). If seal does not meet this requirement, reposition seal (Ref. 49-81-04).

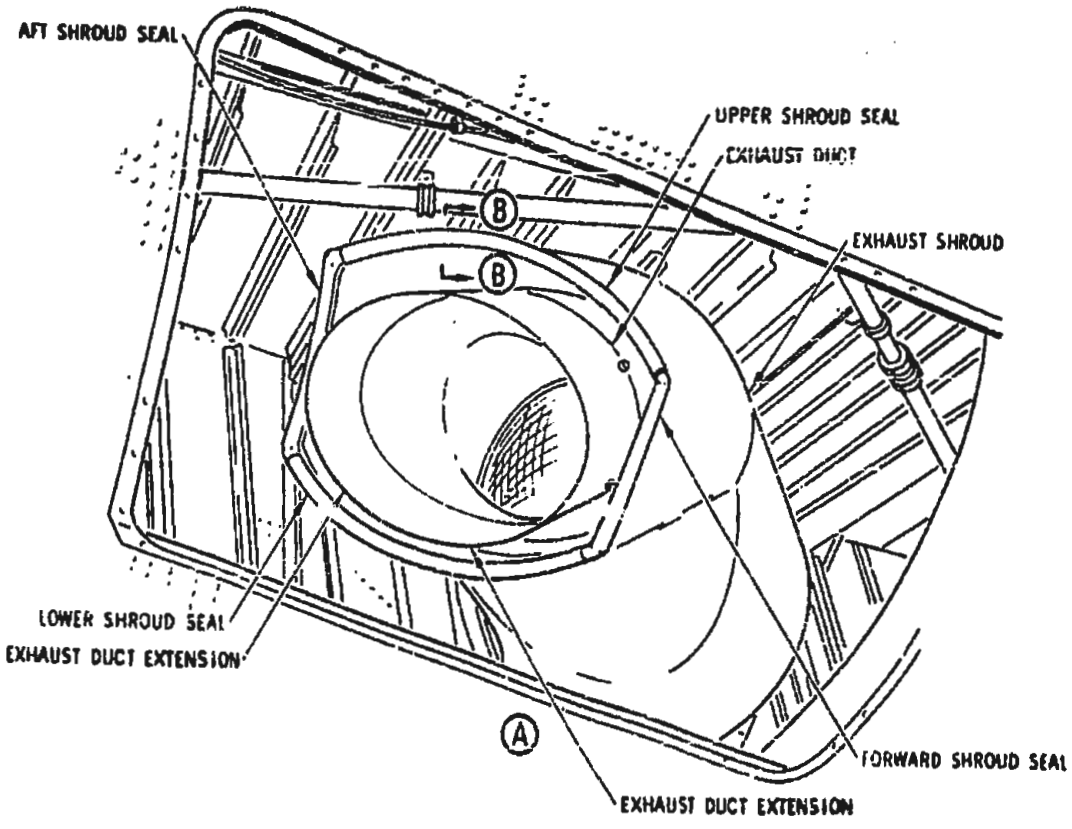
R (12) Close access panels and doors opened in Step 3A(7) and 3A(8).

R (13) Remove control column lock.

R R R R (14) At Flight/Engineer/Second Officers aft circuit breaker panel, CB3, Zone 215, close APU POWER circuit breakers B9 through B17, remove tags from APU CONTROL panel and HYDRAULIC SYSTEM panel.

R R (15) Remove tag from HYDRAULIC SERVICING PANEL in Hydraulic Service Center.



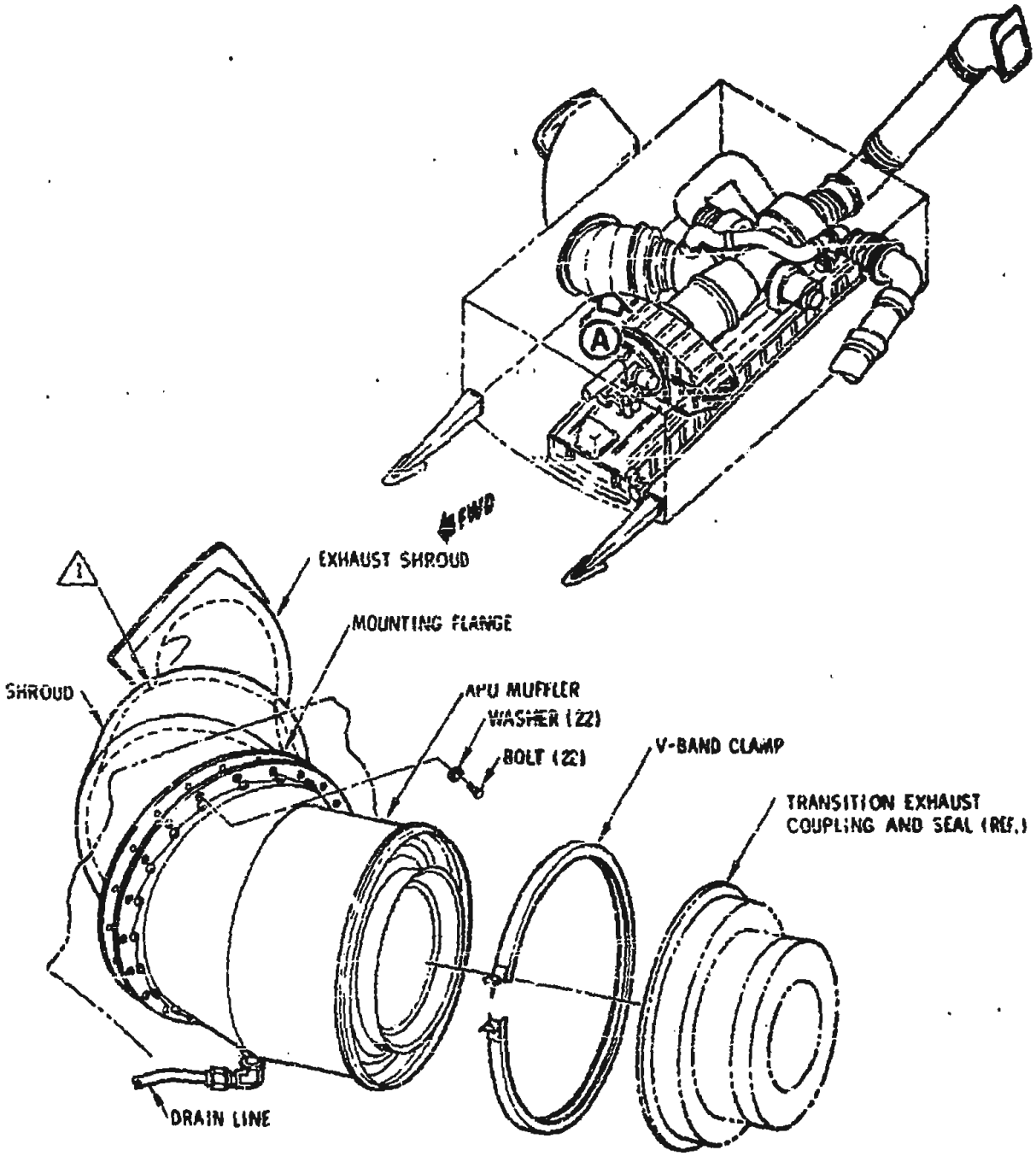


M1-0000-49-985

R R APU Exhaust Shroud - Removal and Installation
Figure 401 (Sheet 1)

R R EFFECTIVITY: ALL

OC B

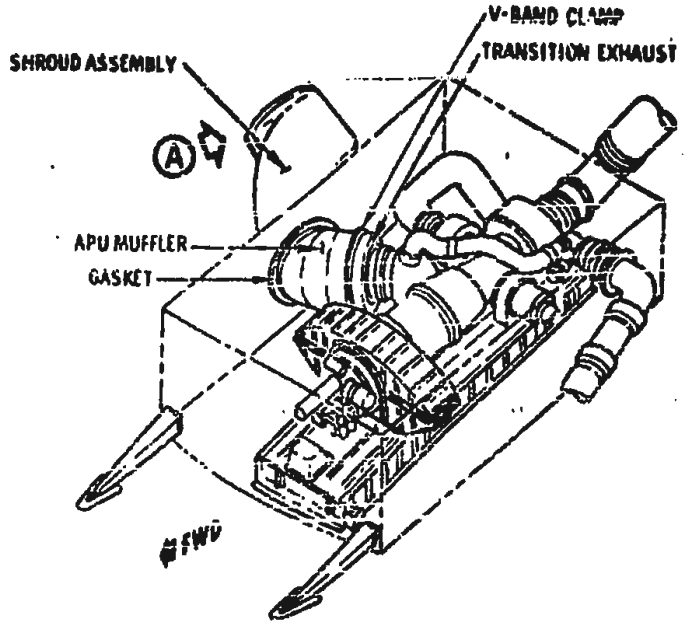


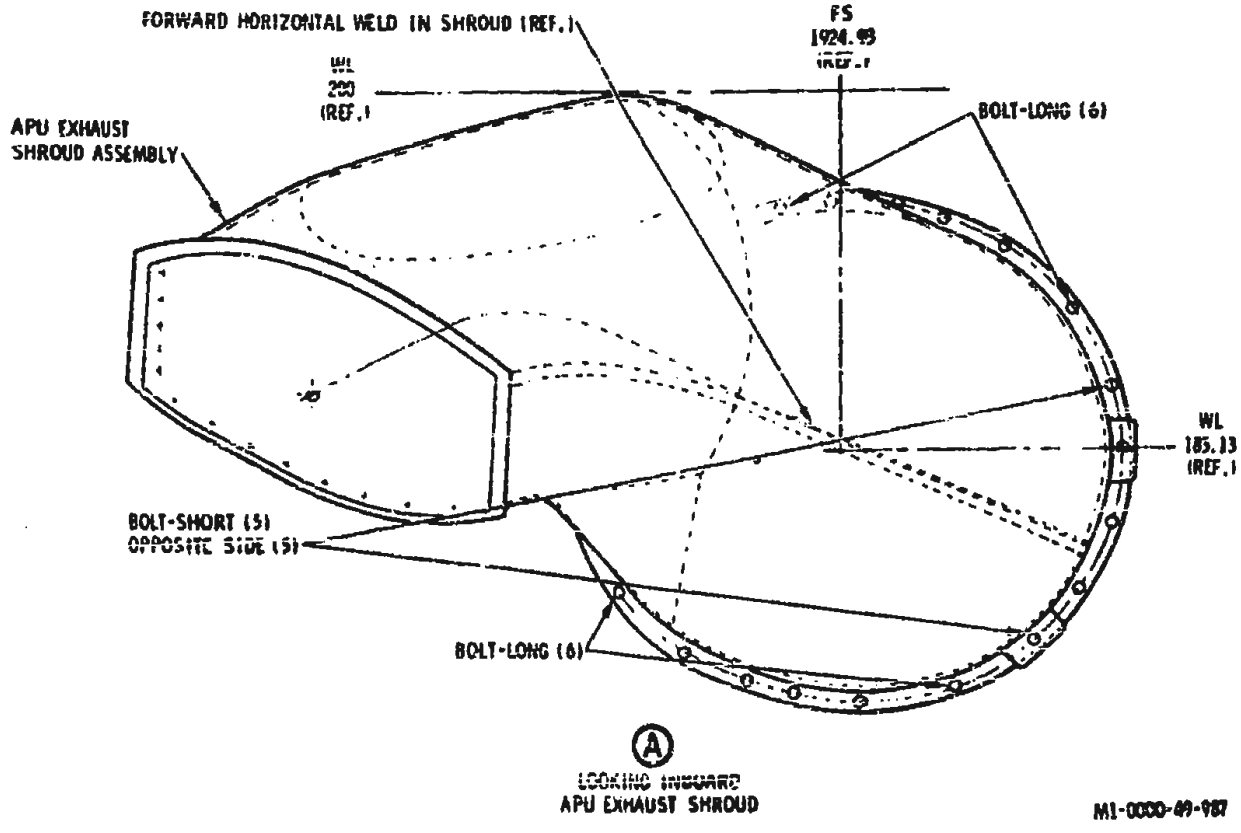
NOTE

1. MUFFLER ASSEMBLY IS ENCLOSED WITHIN AND CONFORMS TO CURVATURE OF EXHAUST SHROUD

MI-0000-69-95A

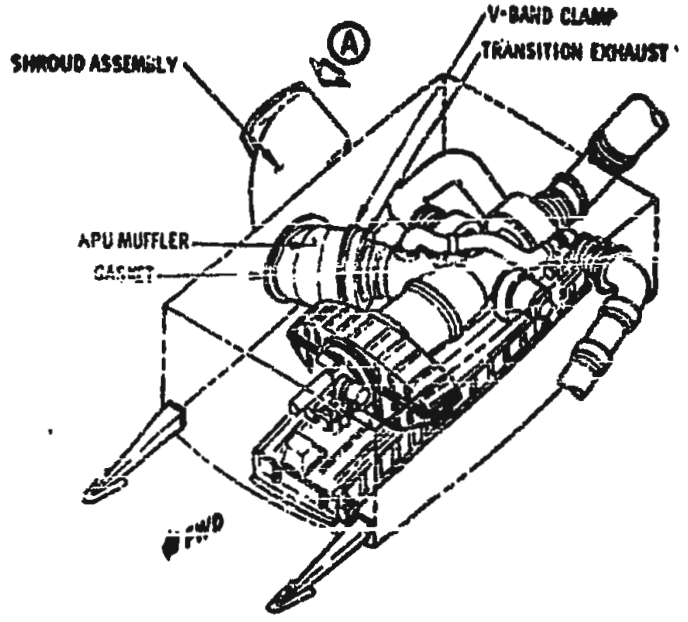
R APU Exhaust Shroud - Removal and Installation
R Figure 401 (Sheet 2)

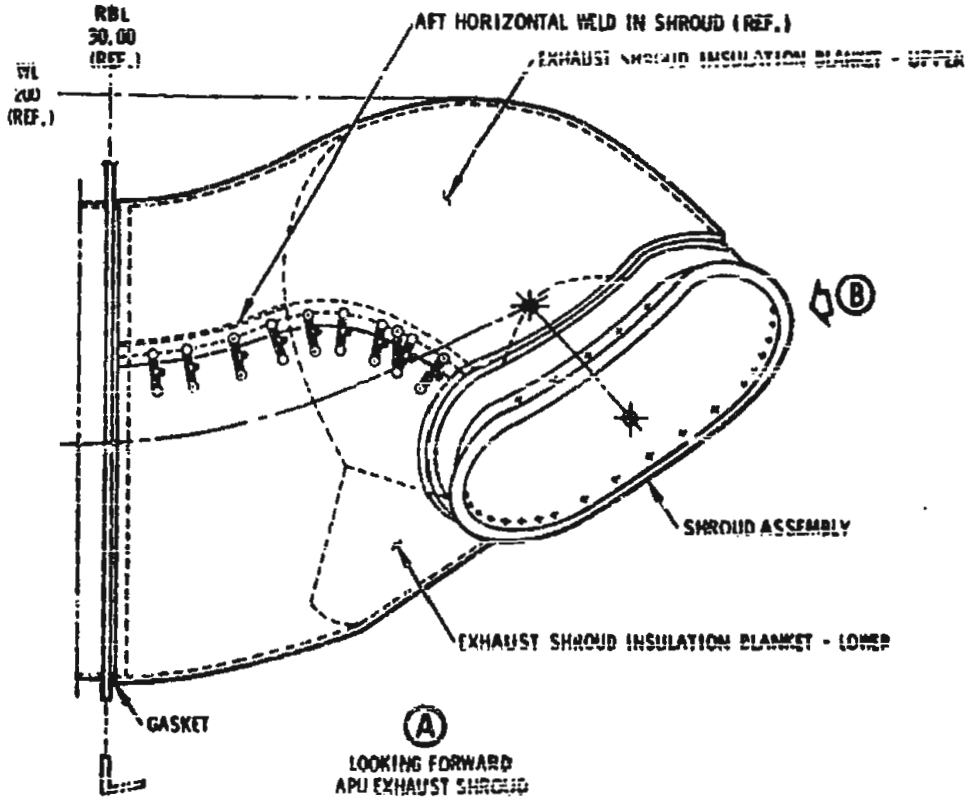




R APU Exhaust Shroud - Removal and Installation
R Figure 401 (Sheet 3)

R EFFECTIVITY: ON AIRCRAFT WITHOUT SB49-058

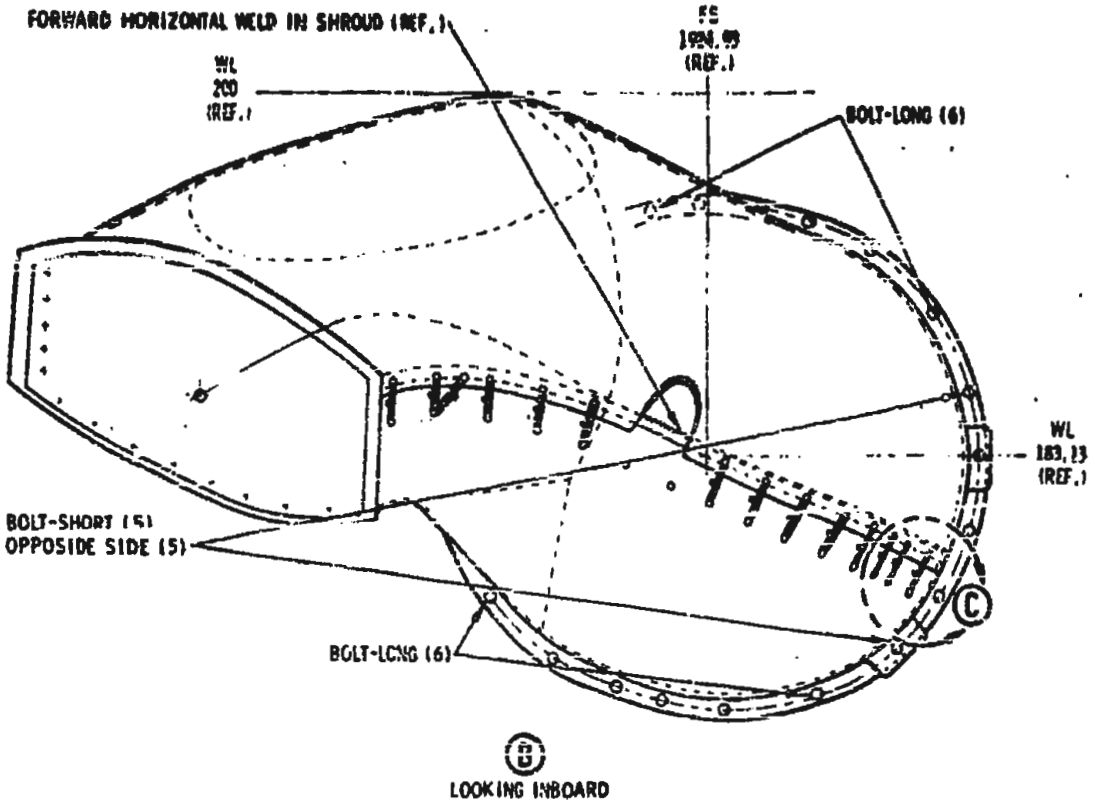




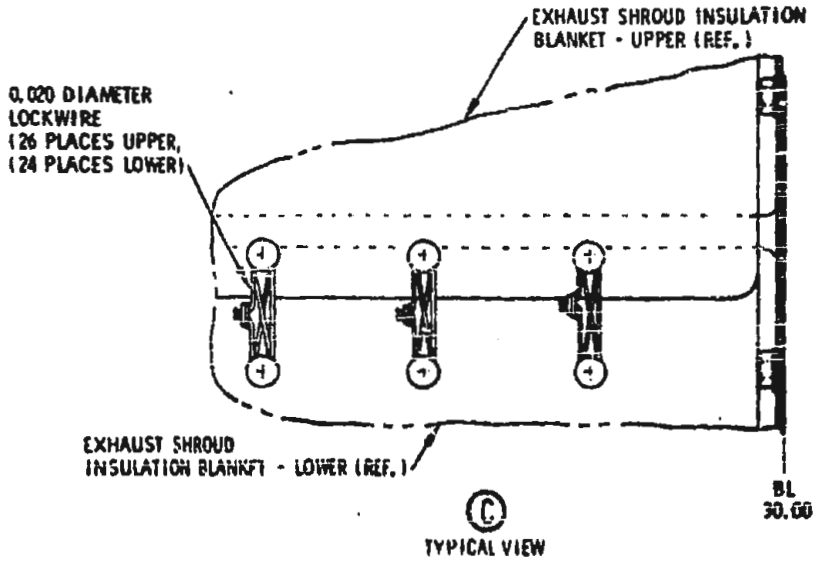
M1-0000-49-908

APU Exhaust Shroud - Removal and Installation
Figure 401 (Sheet 3)

EFFECTIVITY: ON AIRCRAFT WITH SB49-058



B
LOOKING INBOARD

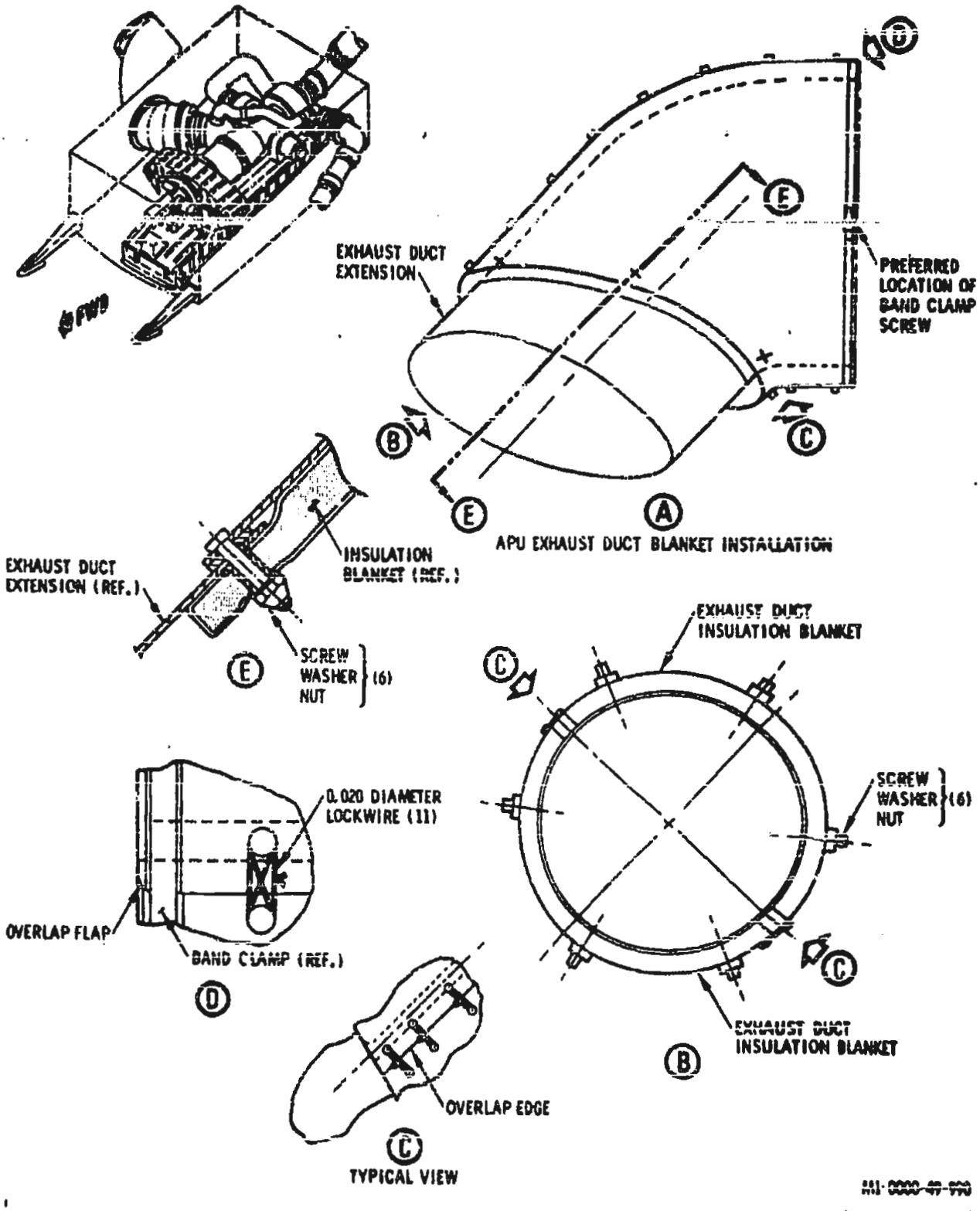


C
TYPICAL VIEW

M1-0000-49-089

R APU Exhaust Shroud - Removal and Installation
R Figure 401 (Sheet 4)

R EFFECTIVITY: ON AIRCRAFT WITH SB49-058
R
001B



R APU Exhaust Shroud - Removal and Installation
R Figure 401 (Sheet 5)

R EFFECTIVITY: ON AIRCRAF WITH SB49-058

001B

APU EXHAUST SHROUD SEALS - REMOVAL AND INSTALLATION

1. General

The APU exhaust shroud-to-access panel 317ER gap is sealed by four interlocking fiberglass reinforced silicone rubber seals. The seals are locally cut to required length and trimmed to fit from seal stock procurable under part number 1556755-125.

2. Equipment and Materials

Seal Stock, PN 1556755-125

CR Adhesive sealant RTV 159, General Electric.

3. Referenced Procedures

6-40-00 Exterior Access Doors and Panels

4. Removal/Installation

A. Removal

(1) On Flight Engineers/Second Officers aft circuit breaker panel CB3, zone 215, open and tag APU POWER circuit breakers B9 through B11.

(2) Attach MAINTENANCE-IN-PROGRESS tag to MASTER POWER switch on APU CONTROL panel.

(3) Gain access to APU exhaust shroud seals by removing afterbody access panel 317ER (Ref. 6-40-00).

(4) Remove exhaust muffler extension (Ref. Fig. 401).

(5) Remove seal retainer fasteners and separate retainers and seals from shroud.

(6) Remove any firewall sealant that may still be adhered to the shroud at the four seal joint locations.

B. Installation

CR CR (1) From 1556755-125 seal material, cut new upper and lower seals (Ref. Fig. 401).

CR (2) Cut to length and trim a section of seal for splicing
CR as shown in Fig. 401 View B.

(3) Use appropriate seal retainer to locate screw hole locations in mating seal. Punch screw holes in seal.

(4) Install upper and lower seals and seal retainers (Ref. Fig. 401, View C).

CR (5) Installforward and aft splice with seals inserted into
CR ends of upper and lower seals (Ref. Fig. 401, View B). Install seal retainers.

(6) Temporarily install access panel 317ER using sufficient attach screws to assure panel positioning (Ref. 6-40-00).

(7) Verify that seals are in full contact with the panel and compressed a minimum of 0.125 in. Note any location where the seal installation does not meet this requirement and perform Step 4B(8). If seal-to-panel contact is satisfactory, remove access panel and proceed with Step 4B(9).

(8) On aircraft 001-023,
if any portion of the seal installation does not bear against the panel as noted above, remove the panel and proceed as follows:

(a) From 0.050-in. mild steel strips, fabricate shims of sufficient total thickness and length to establish proper seal contact when inserted between the seal retainer and seal. Taper the ends of the shims and insert between retainer and seal.

(b) Reinstall 317ER panel as noted in Step 4B(6) and recheck seal-to-panel contact areas (Ref. 6-40-00). Repeat the shimming procedure until the seals are in full contact with the panel at all locations.

(c) Mark location and position of shims and remove seal retainers that require shimming.

(d) Attach shims to retainer using 5/32-in. diameter monel rivets (Ref. Fig. 401, View E).

(e) Reinstall seal retainer.

(8) On aircraft 024-999,
if any portion of the seal installation does not bear

against the panel as noted above, remove the panel and proceed as follows:

(a) Loosen seal retainer fasteners.

(b) Slide seal retainer and seal outward as required to establish specified seal-to-panel contact (Ref. Fig. 401, Views C and E).

(c) Reinstall access panel as noted in Step 4B(6) and recheck seal-to-panel contact areas. Repeat retainer positioning procedure until the seals are in full contact with the panel at all locations.

(d) Tighten seal retainer fasteners.

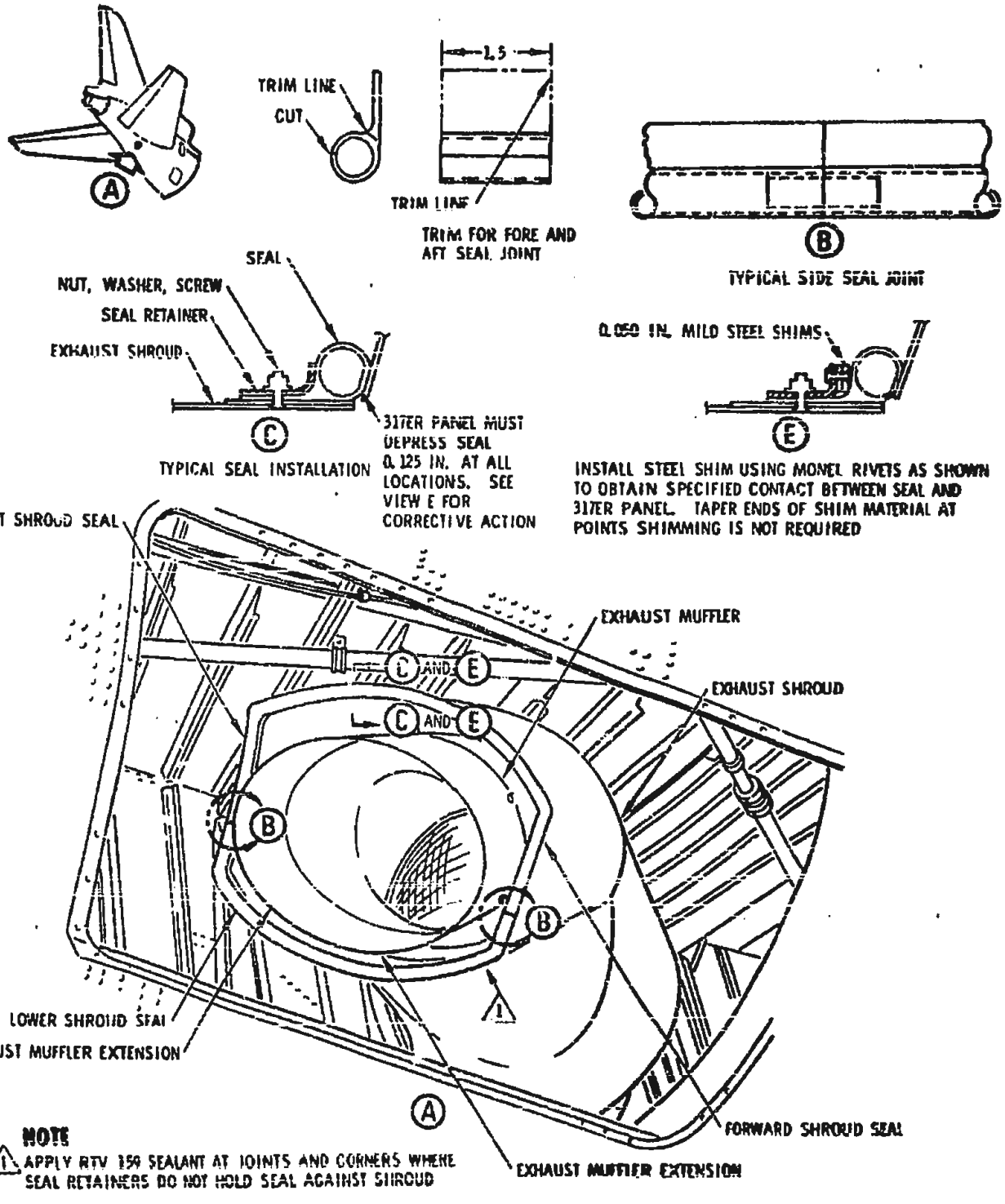
CR CR CR CR (9) With access panel removed, apply RTV 159 sealing compound at each of the two seal joints and where the seal is not clamped to the shroud by the seal retainers.

(10) Complete installation of 317ER access panel (Ref. 6-40-00).

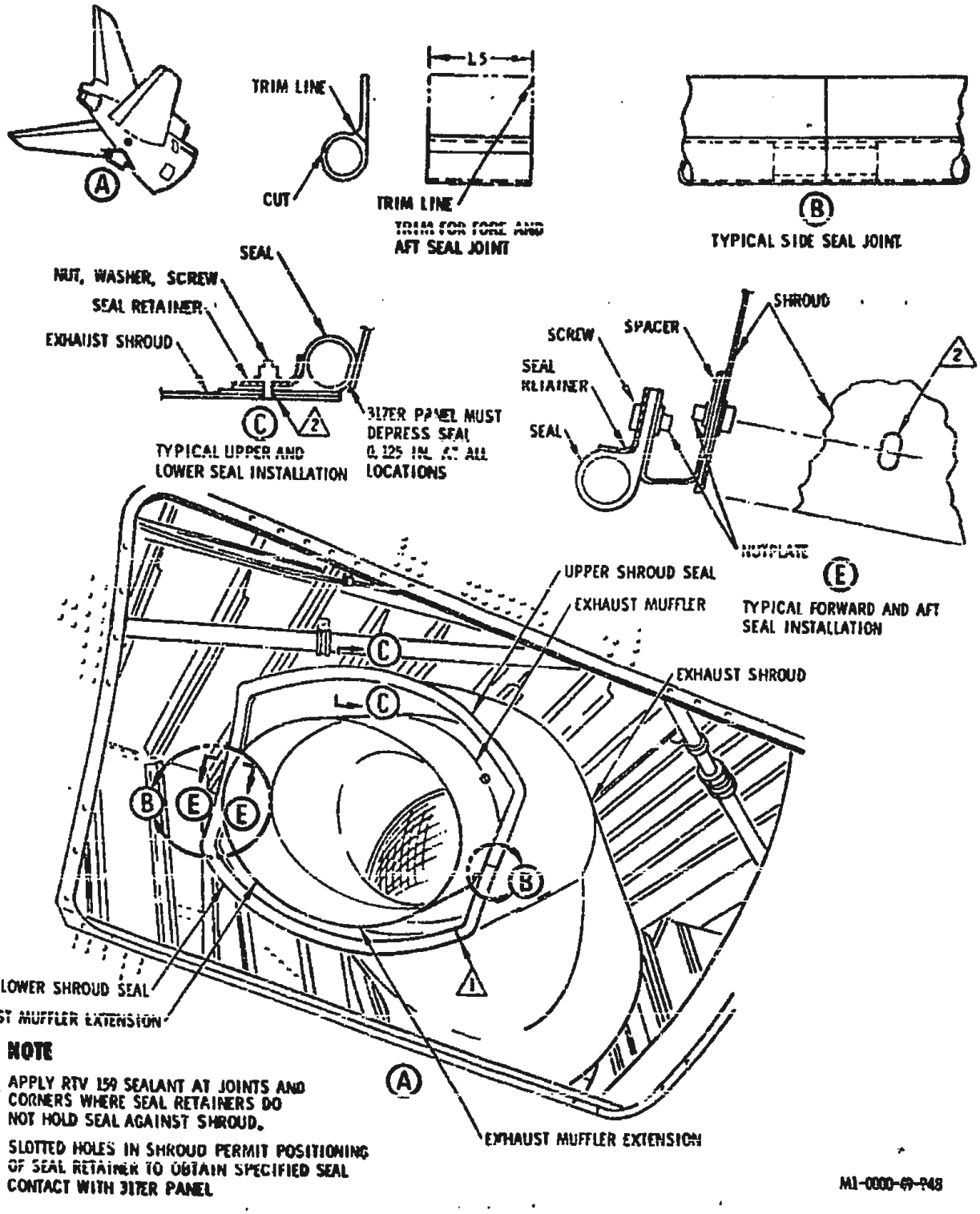
NOTE: Final inspection of the seal installation must verify that the seals are 100 percent effective in sealing the exhaust shroud-to-panel areas.

(11) Reinstall the exhaust muffler extension.

(12) Remove tags and close circuit breakers opened in Step 4A(1) and remove MAINTENANCE-IN-PROGRESS tag installed in Step 4A(2).



CR APU Exhaust Shroud Seals - Removal and Installation
CR Figure 401



NOTE

1. APPLY RTV 159 SEALANT AT JOINTS AND CORNERS WHERE SEAL RETAINERS DO NOT HOLD SEAL AGAINST SHROUD.
2. SLOTTED HOLES IN SHROUD PERMIT POSITIONING OF SEAL RETAINER TO OBTAIN SPECIFIED SEAL CONTACT WITH SHIM PANEL

M1-0000-69-948

CR CR APU Exhaust Shroud Seals - Removal and Installation
Figure 401

OIL SYSTEM - DESCRIPTION AND OPERATION

1. General

Oil system components mounted on the APU platform and engine accessory gearbox include an oil-to-air heat exchanger, a low oil pressure switch, high oil temperature switch, and a low oil quantity sensing switch. These components operate in conjunction with the engine lubricating oil system described in Section 49-21-00.

The oil-to-air heat exchanger is a dual unit; one-half of the heat exchanger is used to cool the engine lubricating oil, the other half cools the APU generator adapter lubricating oil which is in an entirely separate self-contained oil system (Ref. 24-00-00).

R 2. Oil-to-air Heat Exchanger

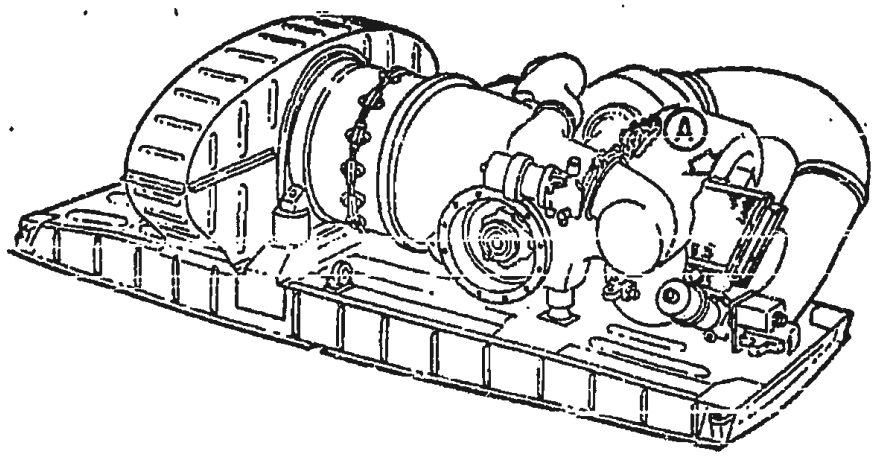
A. Description and Operation

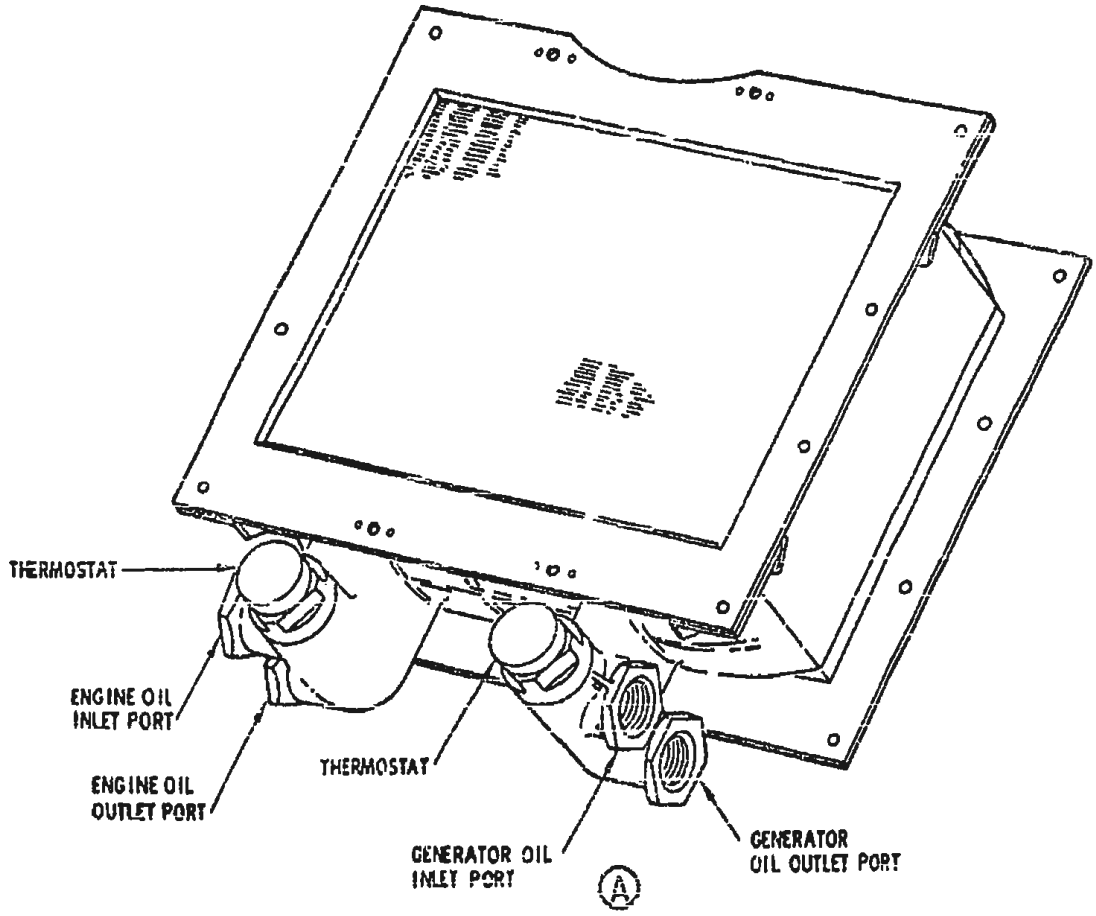
A dual oil-air heat exchanger consisting of a rectangular sheet metal housing and an integral finned tubular heat radiating core is installed between the APU cooling fan transition duct and the APU air vent ejector assembly. Engine and generator oil are directed through separate sections of the unit. Oil flow through each section is regulated by a thermostatically controlled differential pressure sensitive bypass valve located in each oil inlet and outlet port fitting.

Engine and generator oil flows through separate sections of the heat exchanger core. Cooling fan airflow cools the oil by dissipating the heat transmitted to the core structure. In normal operation, oil up to a temperature of 176 degrees F (80 degrees C) flows from the inlet port to the outlet port through the open bypass valve. As oil temperature increases, the thermostat begins to close the bypass valve and oil is directed through the core. The thermostat will also open the bypass port at a differential pressure of 30 psi in the event oil is prevented from flowing freely through the core.

3. High Oil Temperature Switch

A. Description and Operation





M1-0002-49-061

R
R

Oil-to-Air Heat Exchanger
Figure 1

EFFECTIVITY: ALL

001B

A high oil temperature switch (Ref. Fig. 2) consisting of a bimetallic temperature sensitive element and a normally open switch enclosed in a glass insulated stainless steel case is mounted on the accessory gearbox case just below the APU fuel filter. The switch will close whenever the APU power plant lubricating oil temperature increases to 245 degrees F (118 degrees C). When closed, the switch completes a circuit to the electronic control unit which will initiate an APU automatic shutdown and trip the HIGH TEMP OIL fault flag on the APU CONTROL panel.

4. Low Oil Pressure Switch

A. Description and Operation

The low oil pressure switch (Ref. Fig. 2) is mounted on the APU engine accessory gearbox. The switch assembly consists of a pressure sensing diaphragm, a disk spring, pressure plate, and a microswitch, all housed in a stainless steel case having a hermetically sealed electrical harness receptacle.

R The switch is normally open when the APU is shutdown and
R closes after the APU has started and engine oil pressure has
R increased to 57 (±2.5) psig.

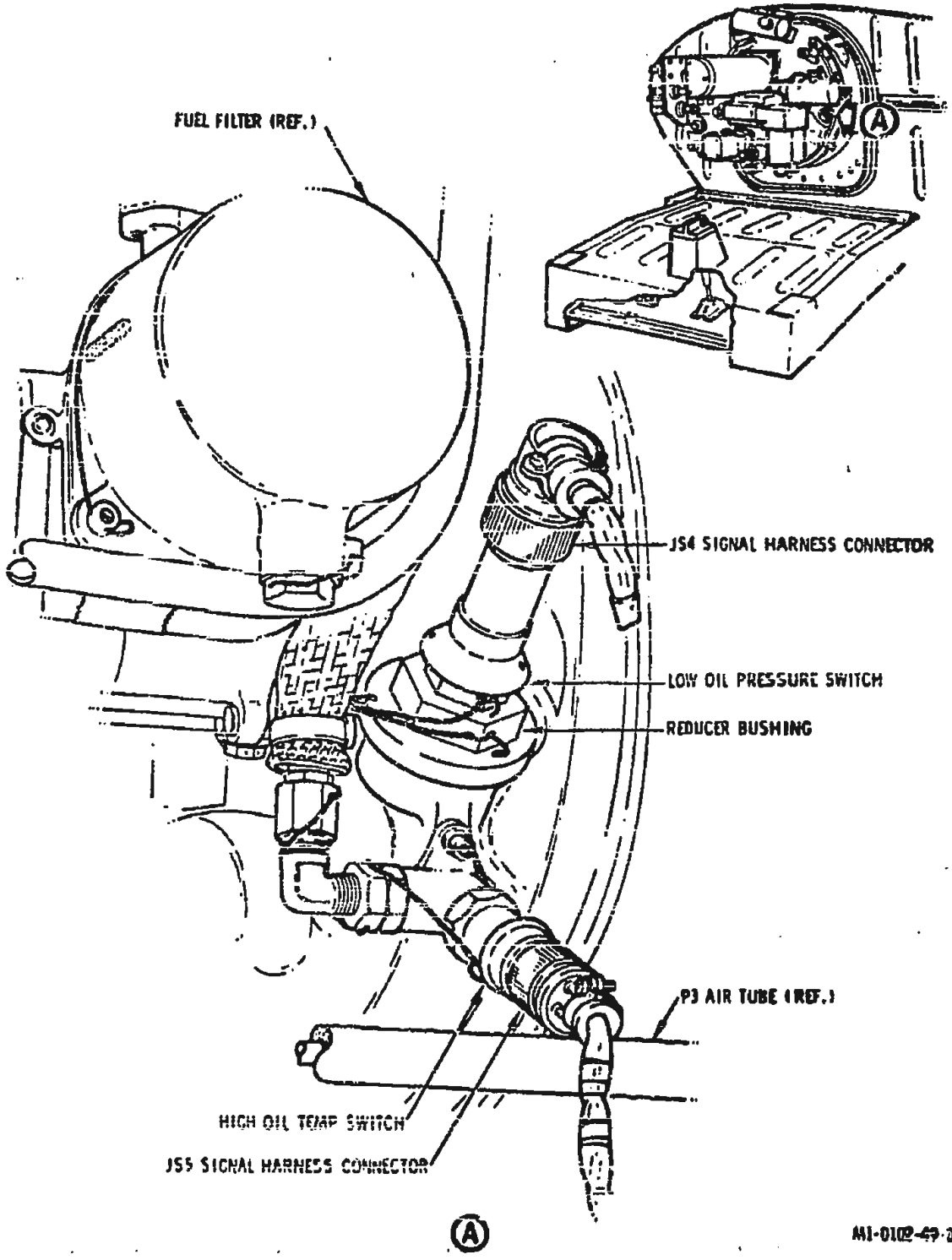
R In event engine oil pressure drops below 50 psig during APU
R operation, the switch will open. The electronic control
R unit (ECU) will react to the open switch position by initiating operation of a 10 second delay counter. If oil pressure is not restored within 10 seconds, the ECU will initiate an automatic APU shutdown and trip the LOW PRESS OIL fault flag on the APU CONTROL panel. During an APU start the low oil pressure automatic shutdown and fault flag circuitry is inhibited until the APU has attained 55% Ng.

5. Low Oil Quantity Switch

A. Description and Operation

An APU low oil quantity sensing circuit will illuminate the LOW OIL QUANTITY light legend on the APU CONTROL panel whenever the APU oil tank level is approximately 3.5 quarts below the normally serviced full tank level. The circuit is actuated by a hermetically sealed, magnetic float operated reed type switch installed in the lower part of the APU oil tank.

The low oil quantity switch (Ref. Fig. 3) is wired through contacts of the NOSE GEAR STEERING RELAY NO. 2 (Ref.

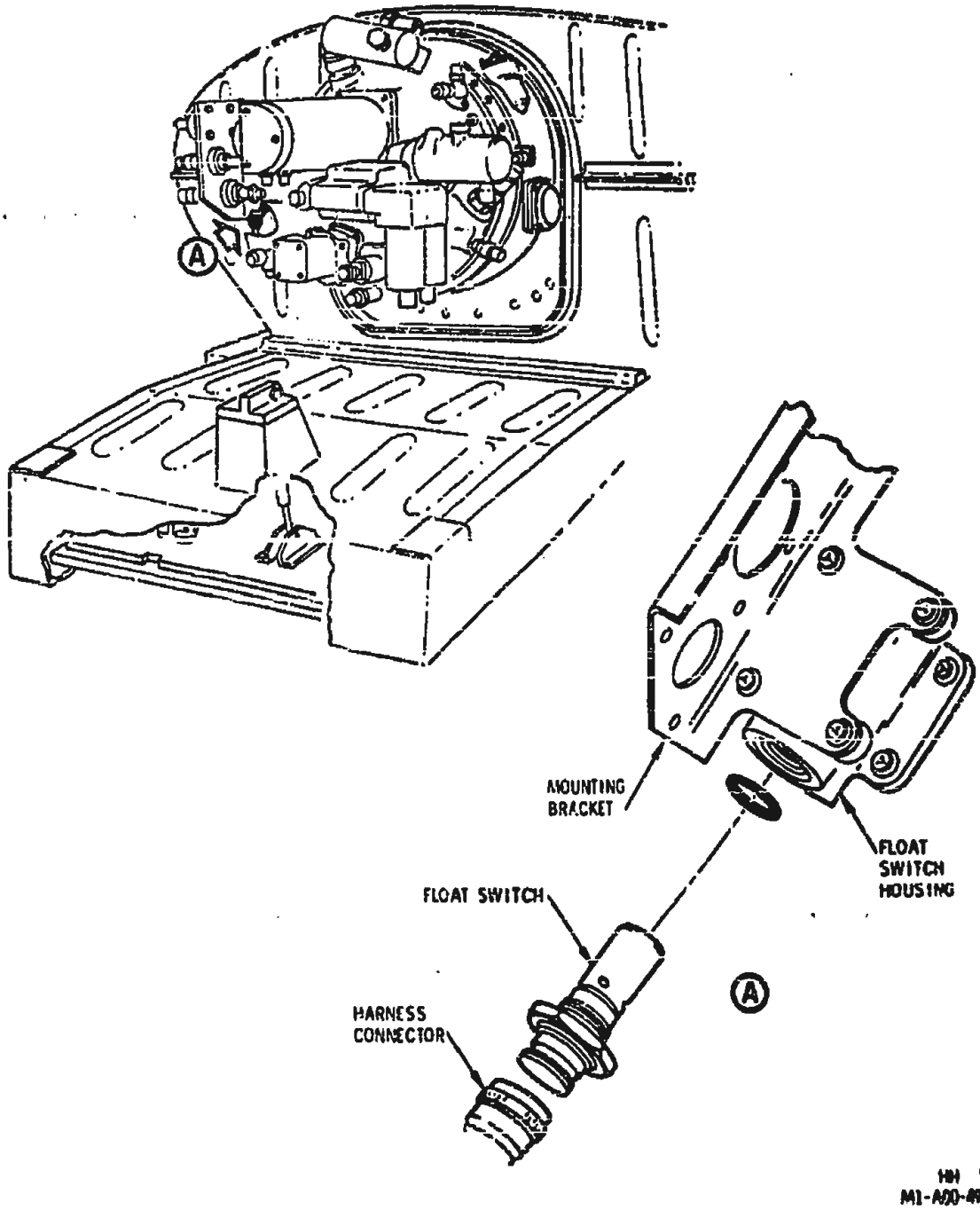


High Oil Temperature and Low Oil Pressure Switches
Figure 2

R

32-63-00). The relay inhibits the low oil quanitty indication circuit when the aircraft is airborne and eliminates the distraction of an erroneous LOW OIL QUANTITY
R light that could occur when the aircraft is rotated for
R takeoff.

R NOTE: When the aircraft is accelerated during the takeoff
R roll, displacement of the oil in the tank may cause
R the float activated switch to close and momentarily
R display a LOW OIL QUANTITY light. This is a normal
R characteristic of the installation and should be no
R cause for alarm.



Low Oil Quantity Switch
Figure 5

R

OIL/AIR HEAT EXCHANGER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Back-up Ring (Ref. Fig. 401)

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Lubricant, Dow Corning 44, or equivalent (procurable from Dow Corning Corp., Midland, Mich.)

Preformed packing (Ref. Fig. 401)

Sealant, RTV 154, or equivalent (procurable from General Electric, Silicone Products Division, Waterford N.Y.)

Drain pan

2. Referenced Procedures

12-12-41	Auxiliary Power Unit - Oil Replenishing
49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test
49-11-20	Air Vent Ejector Assembly - Removal and Installation

3. Removal/Installation

CR CR CR NOTE: Due to dificulty of access, removal/installation of surge valve should be accomplished with APU removed from aircraft.

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breakers B9 through B17.

(2) Open APU compartment access doors, zone 319.

(3) Remove air vent ejector and ejector assembly support (ejector duct guide assembly, Ref. 49-11-20).

(4) Place drain pan under generator adapter oil hose fittings and disconnect oil hoses. Install protective plugs.

(5) Place drain pan under engine oil tube fittings and disconnect engine oil tubes. Install protective plugs in tube nuts.

(6) Remove heat exchanger attach screws (Ref. Fig. 401) and separate heat exchanger from fan housing.

NOTE: It may be necessary to run a spatula around the heat exchanger to fan housing interface to loosen sealant bond.

(7) Remove oil line nipple and elbow fittings. Install protective plugs in oil inlet and outlet ports.

B. Installation

(1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

(2) Lubricate new preformed packing with film of Dow Corning 44, or equivalent, and install on engine oil tube nipples. Install nipples in heat exchanger engine oil inlet and outlet ports and lock-wire nipples.

(3) Install elbow fitting jamnuts and back-up rings. Lubricate new preformed packing and install on elbow with back-up ring seated in recessed area of jamnut.

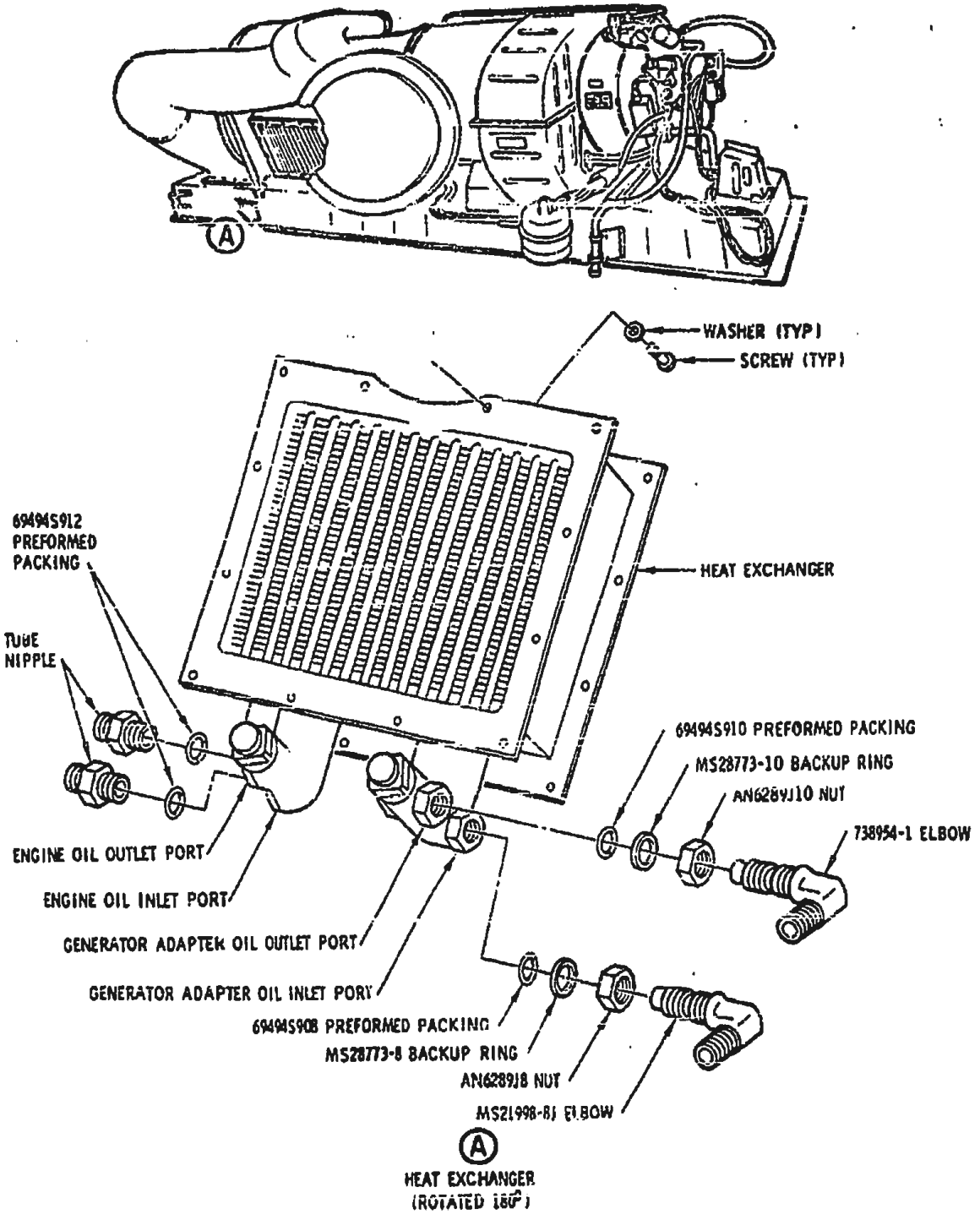
(4) Install elbow in generator adapter oil inlet and outlet ports. Do not torque the elbow fitting nuts at this time.

(5) Apply a film of RTV 154, or equivalent, sealant to the surface of the heat exchanger flange that interfaces with the fan housing. To facilitate future removal apply a coat of wax on the fan housing flange.

(6) Install heat exchanger. Tighten attach screws to a torque of 15 to 20 lb in. higher than the installation torque of 2 to 18 lb in.

(7) Connect generator adapter oil hoses to elbow fittings and tighten the hose nuts until firmly seated. Tighten AN6289-J8 nut to a torque of 120 to 150 lb in. and AN6289-J10 nut to a torque of 240 to 280 lb in., then tighten hose nuts. Lock-wire elbow and hose assembly nuts.

(8) Connect engine oil inlet and outlet lines. Tighten tube nuts to a torque of 450 to 500 lb in. and install lock-wire.



M1-0002-49-596

R Oil/Air Heat Exchanger - Removal and Installation
R Figure 401

EFFECTIVITY: ALL

001B

(9) Reinstall air vent ejector assembly (Ref. 49-11-20).

(10) Remove tags and close circuit breakers opened in Step 3A(1).

(11) Operate APU and check for oil leaks (Ref. 49-00-01).

(12) Check generator adapter oil level and replenish as required (Ref. 24-24-00).

(13) Check engine oil level and replenish as necessary (Ref. 12-12-41).

(14) Close APU compartment access doors.

HIGH OIL TEMP SWITCH - REMOVAL AND INSTALLATION

1. Equipment and Materials

Preformed packing (Ref. Fig. 401

Drain pan

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

24-41-00 External Power/Ground Service System - Maintenance Practices

49-21-01 Auxiliary Power Unit (APU) Assembly - Servicing

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker APU BAT BUS - CONT PWR (S12).

(2) Open access door 319BR in APU compartment.

WARNING: ENSURE THAT APU HAS COOLED SUFFICIENTLY TO PERMIT SAFE SKIN CONTACT.

(3) Disconnect electrical connector from high oil temp switch (Ref. Fig. 401).

(4) Place container beneath switch and remove switch from housing. Discard preformed packing.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Install preformed packing on high oil temp switch.

CAUTION: HANDLE SWITCH CAREFULLY. DO NOT INSTALL SWITCH IN DAMAGED CONDITION.

(3) Turn switch into engine case until switch housing bottoms.

(4) Tighten switch housing and lock-wire.

(5) Install electrical connector.

(6) Replenish engine oil (Ref. 49-21-01).

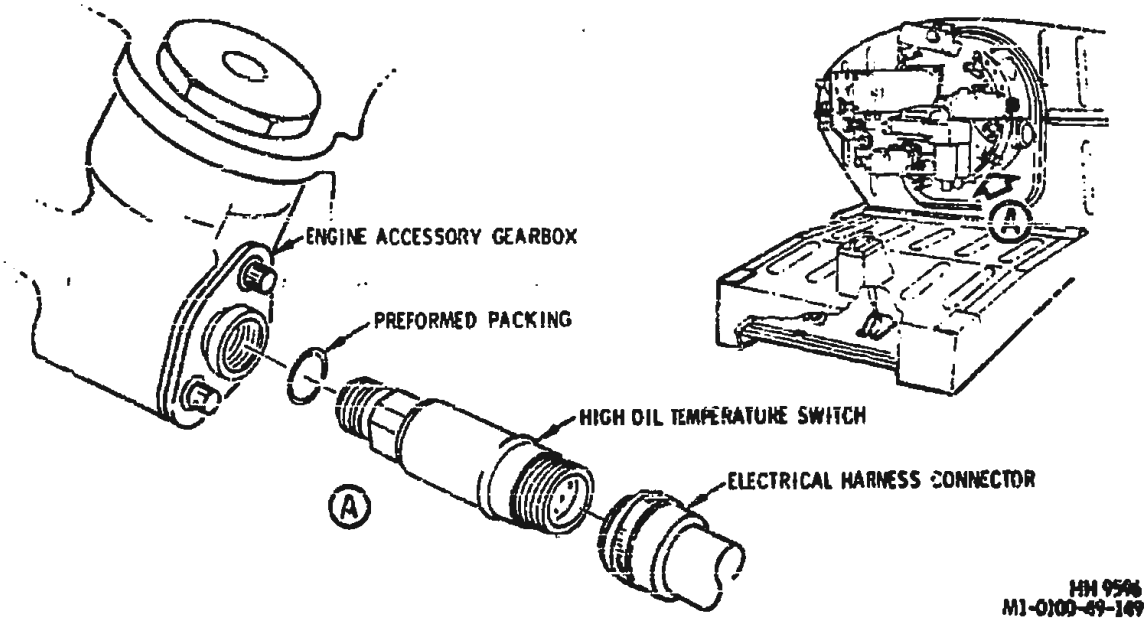
(7) Remove tag and close circuit breaker APU BAT BUS - CONT PWR (S12) opened in Step 3A(1).

(8) Turn on electrical power (Ref. 24-41-00).

(9) On APU control panel, test switch by placing MASTER POWER switch in ON position. The HI TEMP switchlight must not be on.

(10) Turn off electrical power (Ref. 24-41-00).

(11) Close APU compartment access door.



R High Oil Temp Switch - Removal and Installation
R Figure 401

LOW OIL PRESSURE SWITCH - REMOVAL AND INSTALLATION

1. Equipment and Materials

Drain pan

Lockwire, Fed Spec QQ-W-390, 0.020-inch diameter, or equivalent

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

Performed packing (Ref Fig 401)

2. Referenced Procedures

24-41-00	External Power/Ground Service System - Maintenance Practices
49-00-01	Auxiliary Power Unit (APU) - Adjustment and Test
49-21-01	Auxiliary Power Unit (APU) Assembly - Servicing

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breakers APU BAT BUS - POWER CONTROL (S12) and APU POWER - BAT BUS (B10).

(2) Open APU compartment access door 319AL.

(3) Disconnect JS4 signal harness connector at low oil pressure switch (Ref. Fig. 401).

(4) Position drain pan under switch to catch spilled oil when switch is removed.

NOTE: To minimize spillage of oil when switch is removed, have replacement switch ready for installation.

R (5) Cut lock-wire between switch and bushing installed in engine accessory gearbox case.

R (6) To remove switch, unscrew it out of the bushing.

B. Installation

(1) Install new preformed packing on threaded portion of switch and lubricate packing with APU engine oil.

(2) Screw switch into the bushing until it is firmly seated (Ref. Fig. 401).

(3) Tighten switch to a torque of 90 to 100 lb in.

(4) Install 0.032-inch diameter lock-wire between switch and bushing.

CR (5) Connect JS4 signal harness connector to switch.

(6) Check APU oil level and replenish as necessary (Ref. 49-21-01).

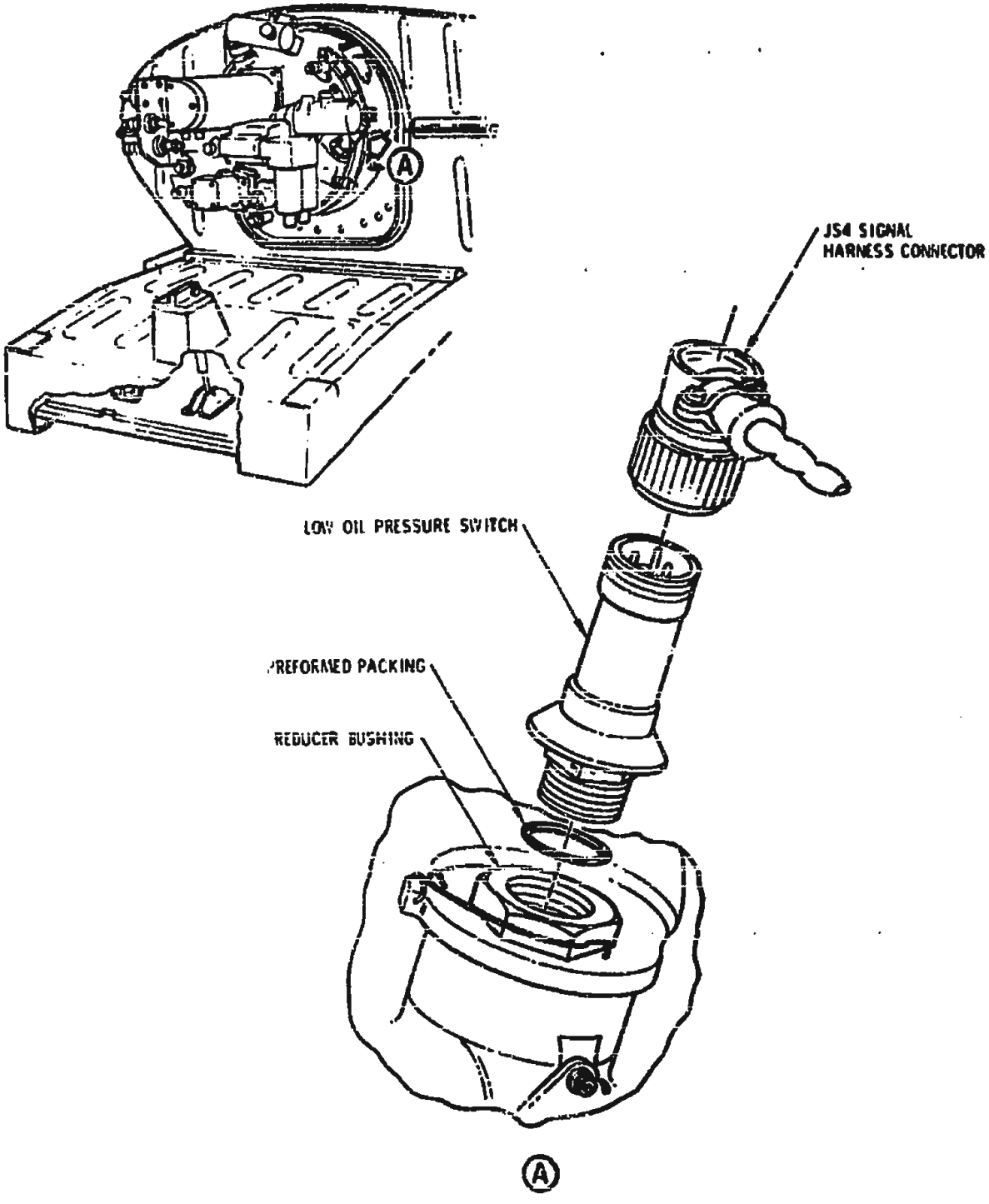
(7) Remove tags and open circuit breakers opened in Step 3A(1).

(8) Operate APU (Ref. 49-00-01). Verify that low oil pressure light stays out when gas generator rpm rises above 55% Ng and APU accelerates to normal operating rpm.

(9) Check switch installation for oil leakage.

(10) Shut down APU.

(11) Close APU compartment access door.



M1-0101-49-150

R Low Oil Pressure Switch - Removal and Installation
R Figure 401

LOW OIL QUANTITY SWITCH - REMOVAL AND INSTALLATION

1. Equipment and Materials

Preformed packing (Ref. Fig. 401)

Drain pan

Lubricating Oil, MIL-L-23699 (for normal operation), no equivalent

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

24-41-00	External Power/Ground Service System - Maintenance Practices
49-21-01	Auxiliary Power Unit (APU) Assembly - Servicing

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker APU
R BAT BUS - CONT POWER (S12).

(2) Open APU access door 3198R, zone 316.

R WARNING: MAKE CERTAIN APU HAS COOLED SUFFICIENTLY FOR SKIN
R CONTACT.

(3) Disconnect electrical connector from oil quantity float switch (Ref. Fig. 401).

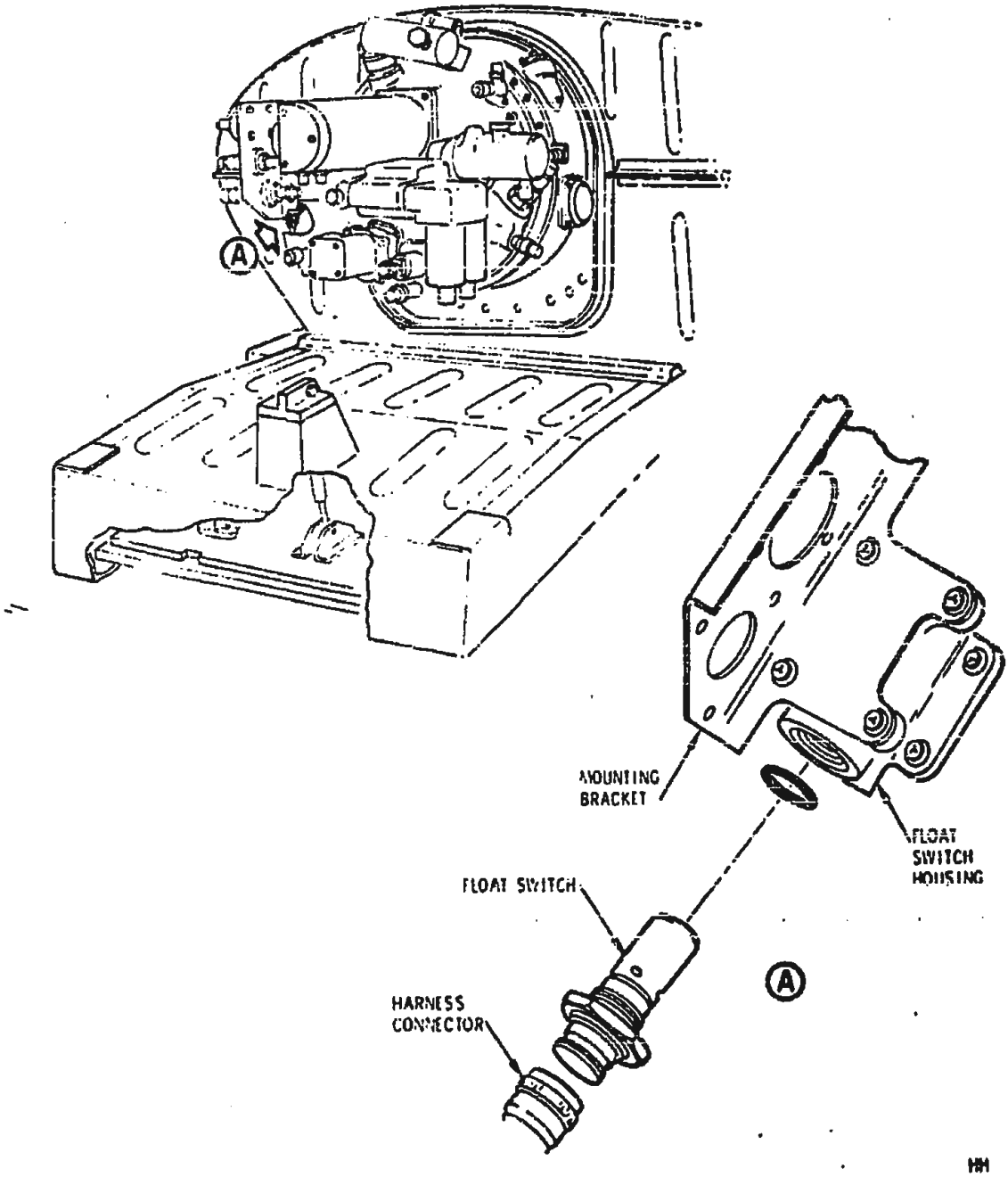
(4) Place drain pan beneath sump plug and drain oil below level of switch housing.

(5) Remove float switch and discard preformed packing.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(1) is open and tagged.

(2) Install preformed packing on float switch (Ref. Fig. 401).



R RR Oil Low Quantity Float Switch - Removal and Installation
Figure 401

EFFECTIVITY: ALL

(3) Turn float switch into housing until flange bottoms tightly.

(4) Lock-wire switch.

(5) Connect electrical connector.

(6) Replenish engine oil (Ref. 49-21-01).

R (7) Remove tag and close circuit breaker APU BAT BUS - CONT
R PWR (S18) opened in Step 3A(1).

(8) Turn on electrical power (Ref. 24-41-00).

(9) Operate APU to test low oil float switch. Low OIL QTY light must be off.

(10) Turn off electrical power (Ref. 24-41-00).

(11) Close access door.

R HIGH TEMP FAULT INDICATOR FLAG - MAINTENANCE PRACTICES

R 1. General

R This procedure provides information to verify the high oil
R temperature auto shutdown function is operational.

R 2. Referenced Procedures

R 24-00-00 External Power - Maintenance Practices

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

R 3. High Oil Temperature Auto Shutdown Verification

R A. On Flight Engineer/Second Officers aft circuit breaker panel
R CB3, zone 215, open and collar circuit breaker APU BAT BUS -
R CONT PWR (S12).

R B. Open access door 319BR in APU compartment.

R WARNING: ENSURE THAT APU HAS COOLED SUFFICIENTLY TO PERMIT
R SAFE SKIN CONTACT.

R C. Disconnect electrical connector from high oil temp switch
R and insert a jumper wire between connector pins A and B.

R D. Remove collar from circuit breaker opened in Step 3A and
R attempt to start APU (Ref. MM 49-00-01).

R E. Verify circuit operation by observing that Ng speed will not
R exceed 18 percent (no fuel).

R F. Remove jumper and install electrical connector JS5.

R G. Operation of oil temperature switch can be verified by
R removing the switch from the system and checking per
R appropriate overhaul manual procedure.

R H. Close APU compartment access door 319BR.

R LOW PRESSURE FAULT INDICATOR FLAG - MAINTENANCE PRACTICES

R 1. General

R This procedure provides information to verify the low oil
R pressure auto shutdown function is operational.

R 2. Referenced Procedures

R 49-00-01 Auxiliary Power Unit (APU) - Adjustment and Test

R 3. Low Oil Pressure Auto Shutdown Verification

R A. On Flight Engineer/Second Officers aft circuit breaker panel
R CB3, zone 215, open and collar circuit breakers APU BAT BUS
R - POWER CONTROL (S12) and APU POWER - BAT BUS (B10).

R B. Open APU Compartment access door 319AL.

R C. Disconnect JS4 signal harness connector at low oil pressure
R switch.

R D. Remove collars and close circuit breakers opened in Step 3A.

R E. Verify that electrical continuity does not exist between
R switch connector pins A and B.

R F. Verify circuit operation by starting APU and observing that
R APU shutdown occurs 10 seconds after Ng speed reaches 55
R percent (Ref. MM49-00-01).

R G. Install JS4 signal harness connector on low oil pressure
R switch.

R H. Close APU compartment access door.

R APU LOW OIL QUANTITY INDICATOR LIGHT - MAINTENANCE PRACTICES

R 1. General

R The following deactivation procedure is applicable to an
R inoperative LOW OIL QUANTITY indicator light on the APU CONTROL
R panel.

R 2. Referenced Procedure

R 12-12-41 Auxiliary Power Unit - Oil Replenishing

R 3. Deactivation

R NOTE: This deactivation procedure applies only when an aircraft
R is to be dispatched in accordance with the MEL.

R A. Low Oil Quantity Indicator Light

R (1) Verify that the APU oil reservoir is properly serviced
R with the required amount of oil (Ref. 12-12-41).

R (2) Install appropriate placard in the flight station at a
R location clearly visible to the flight crew.

R (3) Enter item in aircraft maintenance log.